FORD
TRACTOR

for

FORD TRACTOR SERIES
2000 AND 4000 *Select-O-Speed*
TRANSMISSION
(DIRECT DRIVE CLUTCH MODELS)

CM 101102

shop manual supplement

SELECT-O-SPEED TRANSMISSION SHOP MANUAL SUPPLEMENT

for

FORD TRACTOR SERIES
2000 AND 4000
(DIRECT DRIVE CLUTCH MODELS)

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FOREWORD

This manual supplements Chapter II, Part Two, of the Ford Tractor Shop Manual, Form No. SE 8175. It contains service procedures applicable to the Select-O-Speed transmission on the 1963 production Ford Tractors, Series 2000 and 4000.

Reference should be made to the original Shop Manual for Select-O-Speed transmission removal and installation procedures, as they remain unchanged. Refer to the index on the opposite page for information and procedures contained in this supplement.

Keep this supplement with your copy of the Tractor Shop Manual, and in a location where it will be readily available for use at all times.

SERVICE DEPARTMENT
TRACTOR AND IMPLEMENT OPERATIONS (U.S.)
FORD TRACTOR DIVISION
FORD MOTOR COMPANY

TABLE OF CONTENTS

Part TWO—CLUTCH, TRANSMISSIONS, REAR AXLE, AND POWER TAKE-OFF

Chapter II—TRANSMISSIONS

Section *Page*

1 REMOVAL AND INSTALLATION
2 CLEANING AND INSPECTION – ALL EXCEPT SELECT-O-SPEED
3 FOUR SPEED TRANSMISSION
4 FIVE SPEED TRANSMISSION
5 SHERMAN STEP-UP AND STEP-DOWN TRANSMISSION
6 SHERMAN REVERSING TRANSMISSION
12 SPECIAL TOOLS

Refer to Page 168 of the Ford Tractor Shop Manual, SE 8175, for these sections.

7 DESCRIPTION AND OPERATION – SELECT-O-SPEED TRANSMISSION 1

- Planetary Gear Train 1
- Bands and Servos 3
- Clutch Packs 5
- Transmission Power Flows 5
- Hydraulic Control System 8
- Transmission Controls 16

8 MAINTENANCE AND ADJUSTMENTS 18

- Maintenance 18
- Adjustments 19

9 TROUBLE SHOOTING 25

- Trouble Shooting Low Circuit Pressures 29
- Trouble Shooting Chart 30
- Table I – Diagnosis Guide 31
- Table II – Diagnosis Guide 32

10 SERVICING THE TRANSMISSION 33

- Assemblies Serviced with Transmission Installed 34
- Assemblies Serviced with the Tractor Split at Rear of Transmission 40
- Assemblies Serviced with the Tractor Split Ahead of the Transmission 49
- Assemblies Serviced with the Transmission Removed 52
- Disassembly, Repair, and Assembly of Sub-Assemblies 5

11 SPECIFICATIONS – SELECT-O-SPEED TRANSMISSION ....

Part TWO

CLUTCH, TRANSMISSIONS, REAR AXLE AND POWER TAKE-OFF

Chapter

II

Transmissions

Section		*Page*
7	Description and Operation – Select-O-Speed Transmission	1
8	Maintenance and Adjustments	18
9	Trouble Shooting	25
10	Servicing the Transmission	33
11	Specifications – Select-O-Speed Transmission	66

7. DESCRIPTION AND OPERATION – SELECT-O-SPEED TRANSMISSION

The Select-O-Speed Transmission is available in three models. The basic transmission remains unchanged for all tractors, and the differences exist only in the following Power Take-Off options:

No P.T.O.

Single speed independent
engine-driven P.T.O.

Two speed independent engine-
driven P.T.O., and proportional
ground speed P.T.O.

The transmission provides for ease of control and high efficiency in the utilization of engine power and engine fuel. It is a manually selected, hydraulically controlled system, which transmits power from the engine through four planetary gear sets, providing the ten forward speed ratios and two reverse speed ratios to the final drive of the tractor. Park and Neutral positions are also provided.

A brief description and the principles of operation of the major assemblies in the transmission are discussed in this section. All design and operational differences between the transmission models are fully explained.

PLANETARY GEAR TRAIN

For purposes of identification, the four planetary gear systems used in the transmission have been labeled from front to rear, "A", "B", "C", and "D", as shown in Figure 1. The ten forward and two reverse speeds are obtained by controlling the movement of the elements within the planetary gear systems.

Each of the planetary gear systems is comprised of three elements; a sun gear, a carrier with three pinions, and a ring gear, as shown in Figure 2. The three pinions are mounted within the carrier frame and rotate on needle bearings around pinion shafts, which are secured to the carrier frame. The sun gear, which is centered between the pinions, has external teeth. The ring gear, which encompasses the pinions, has internal teeth. All of the gears in the planetary system are constantly in mesh.

When a planetary system is connected to a source of power, all of the components in the system will rotate unless an external force is applied to hold an element. The sun gear, carrier, and the ring gear, can rotate on the central axis of the system and the pinions will rotate on their own axes at the same time as they are being carried around the central axis.

Planetary Gear Power Flow

Depending upon which element of a planetary system is held, power can be applied or taken out at the sun gear, carrier, or ring gear. The general flow of power through the planetary system will be as follows:

1. Applying power to the sun gear and holding the ring gear forces the pinions to rotate on their own axes and "walk" within the ring gear, taking the carrier

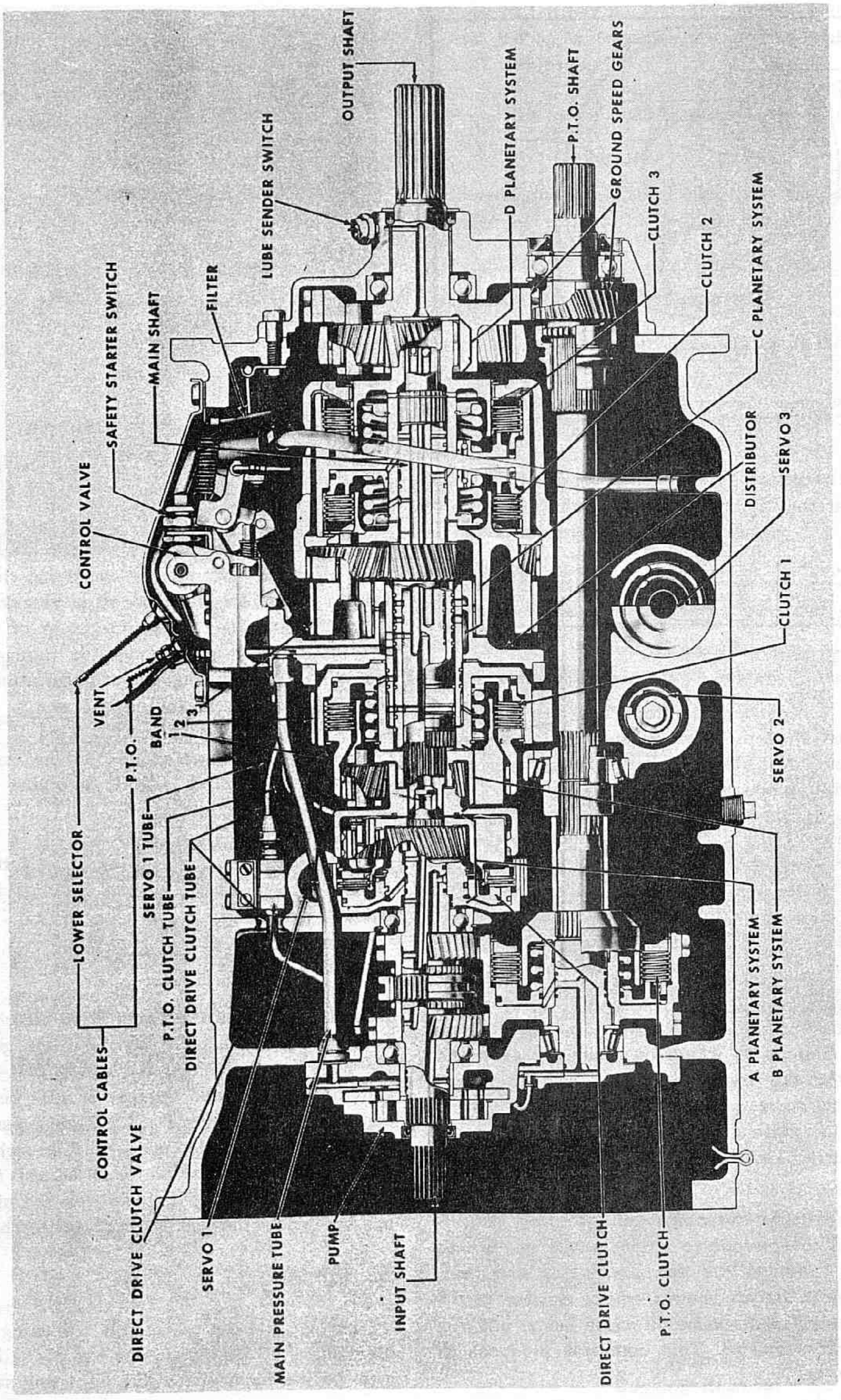


Figure 1
The Two Speed Independent P.T.O. and Proportional Ground Speed P.T.O. Select-O-Speed Transmission—Sectional View

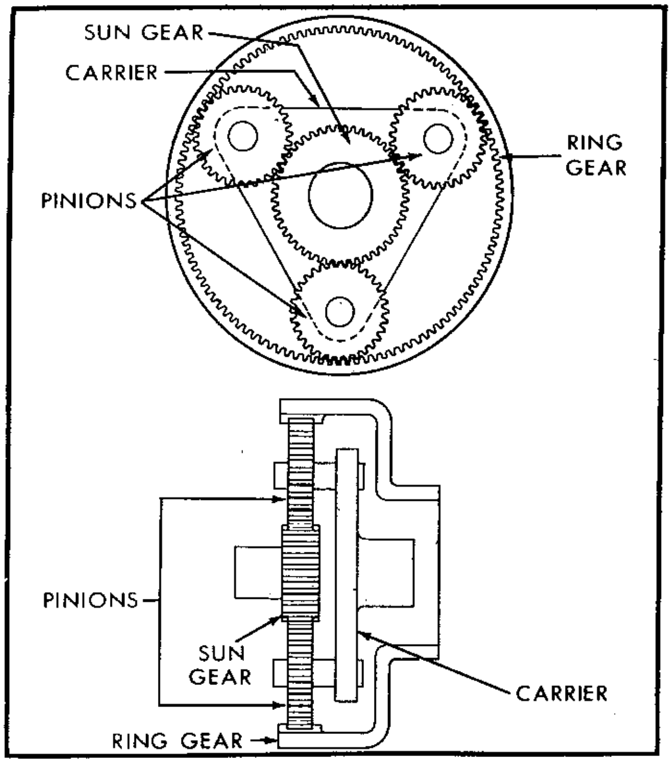


Figure 2
Planetary System – Front and Side View

with them. The carrier, therefore, becomes the power output member of the system, turning in the same direction but at a slower speed than the sun gear. This condition produces an underdrive ratio.

2. Applying power to the ring gear and holding the sun gear forces the pinions to rotate on their own axes and "walk" around the sun gear, taking the carrier with them. The carrier, therefore, becomes the power output member of the system, turning in the same direction but at a slower speed than the ring gear. This condition produces an underdrive ratio.
3. Applying power to the carrier and holding the ring gear forces the pinions to rotate on their own axes and "walk" within the ring gear. The sun gear, therefore, becomes the power output member of the system, turning in the same direction but at a higher speed than the carrier. This condition produces an overdrive ratio.
4. Applying power to the carrier and holding the sun gear, forces the pinions to rotate on their own axes and "walk" around the sun gear. The ring gear, therefore, becomes the power output member of the system, turning in the same direction but at a higher speed than the carrier. This condition produces an overdrive ratio.
5. Applying power to the sun gear and holding the carrier, forces the pinions to act as idlers, rotating in the opposite direction on their own axes. This drives the ring gear at a lower speed and in the opposite direction from the sun gear. This condition produces an underdrive reverse ratio.
6. Applying power to the ring gear and holding the carrier, forces the pinions to act as idlers, rotating in the same direction on their own axes. This drives the sun gear at a higher speed and in the opposite direction from the ring gear. This condition produces an overdrive reverse ratio.
7. Locking any two units of a planetary system together results in a direct drive with no change in speed or direction of rotation.

BANDS AND SERVOS

The transmission uses three servo-operated brake bands, shown in Figure 1. The bands hold three planetary gear elements and operate in conjunction with the hydraulic packs for the various power flows through the transmission. The bands are made of steel and have metallic or asbestos composition linings bonded to the inside surface. For purposes of illustration and reference, the bands have been labeled 1, 2, and 3.

All three bands are controlled by corresponding hydraulic servos which contain a piston and rod, return spring, and spring retainer.

In operation, the servos control the action of the bands on the various planetary gear elements in the following manner:

A. Band No. 1

Band 1 encircles the direct drive clutch housing which is attached to the planetary "A" sun gear. One end of the band contacts the inner end of the adjusting screw and the opposite end engages a strut between the band and the servo piston rod. When fluid pressure is directed to the servo, force is transmitted through the piston rod and strut to tighten the band around the drum. When hydraulic pressure is removed from the piston, the servo spring releases the band and the fluid is exhausted to sump.

B. Band No. 2

Band 2 encircles the clutch 1 housing splined to the planetary "B" ring gear. One end of the band contacts a strut on the inner end of the adjusting screw. The other

GEAR RATIO	*DIRECT DRIVE * CLUTCH*	*BAND SERVO*			*CLUTCH PACK*		
		B_1*	B_2**	B_3**	C_1*	C_2*	C_3*
Park (P)	A		A	A	A		
R2		A		A	A		
R_1	A			A			
Neutral (N)	A			A			
1st	A			A			A
2nd	A			A		A	
3rd		A		A			A
4th		A		A		A	
5th	A		A				A
6th	A		A			A	
7th		A	A				A
8th		A	A			A	
9th	A				A	A	
10th		A			A	A	

* *Pressure Applied*
***Spring Applied*

Figure 3
Application of Bands and Clutch Packs for each Gear Ratio

end of the band engages a strut between the band and servo 2 actuating lever. In operation, band 2 is mechanically applied by spring pressure until fluid pressure is directed to servo 2 to hydraulically release the band from the clutch housing. When the fluid pressure is removed, the spring discharges the fluid and applies the band.

C. Band No. 3

Band 3 encircles the planetary "C" carrier. One end of the band contacts a strut on the inner end of the adjusting screw and the opposite end engages the strut between the band and servo 3 actuating lever. In operation, band 3 is mechanically applied under spring pressure until fluid pressure is directed to servo 3 to hydraulically release the band from the carrier. When fluid pressure is removed, the spring discharges the fluid and applies the band.

The following chart shows the band application and the other planetary elements affected:

Band	*Applied*	*Planetary Element Involved*
1	Hydraulically	Sun Gear "A"
2	*Mechanically	Ring Gear "B" and Sun Gear "C"
3	*Mechanically	Carrier "C"

*Bands 2 and 3 are hydraulically released.

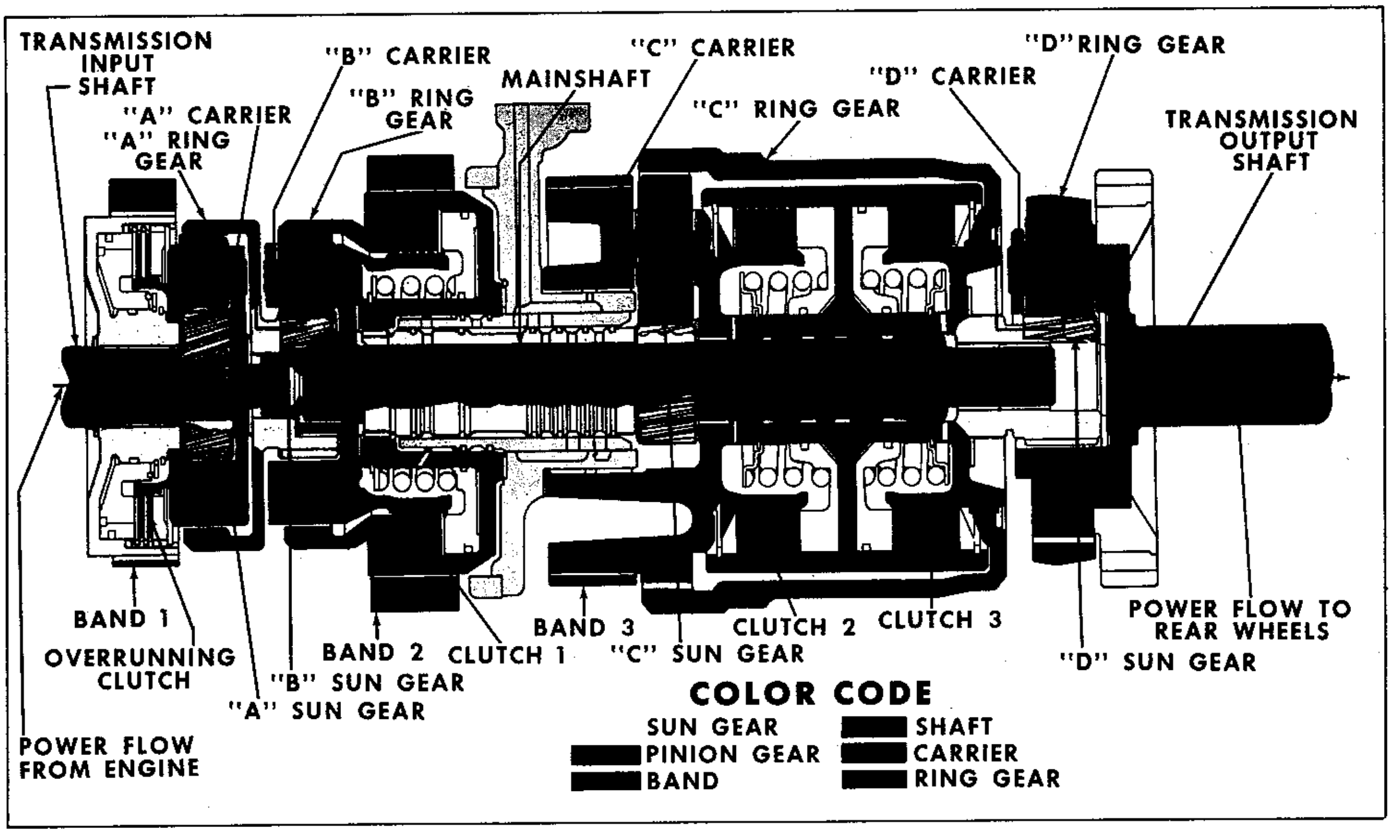


Figure 4
Select-O-Speed Planetary Gear Train

CLUTCH PACKS

In addition to the brake bands used to control planetary gear operation, the Select-O-Speed Transmission incorporates four multiple-disc clutch packs. For purposes of illustration and reference, the clutch packs have been labeled direct drive, 1, 2, and 3, as shown in Figure 1. These clutches are used to link two elements of one planetary system or the elements of adjacent planetaries together to obtain the desired power flow. The four hydraulically operated clutch packs in the transmission are all basically the same and are composed of the clutch housing, the clutch piston, the piston inner seal, the piston outer seal, a return spring and retainer, a series of steel and bronze plates, a pressure plate and retainer snap ring. The steel plates have external splines which engage with the clutch housing and the bronze plates have internal splines which engage a planetary gear element.

When fluid pressure is applied to a clutch pack, the pressure moves the piston compressing the return spring which in turn locks the steel and bronze plates together, engaging the clutch. The piston is returned to the released position by the return spring after hydraulic pressure has been removed. With the exception of the direct drive clutch, the steel clutch plates contain a slightly dished form to maintain positive separation while the clutch is released.

The function of each individual clutch assembly is listed in the following table:

Clutch	*Planetary Elements Combined*
Direct Drive	Sun "A" – Carrier "A"
1	Carrier "B" – Ring Gear "B"
2	Carrier "B" – Carrier "C"
3	Carrier "B" – Sun Gear "D"

TRANSMISSION POWER FLOWS

When certain combinations of elements in the planetary gear train of the transmission are held by the bands and

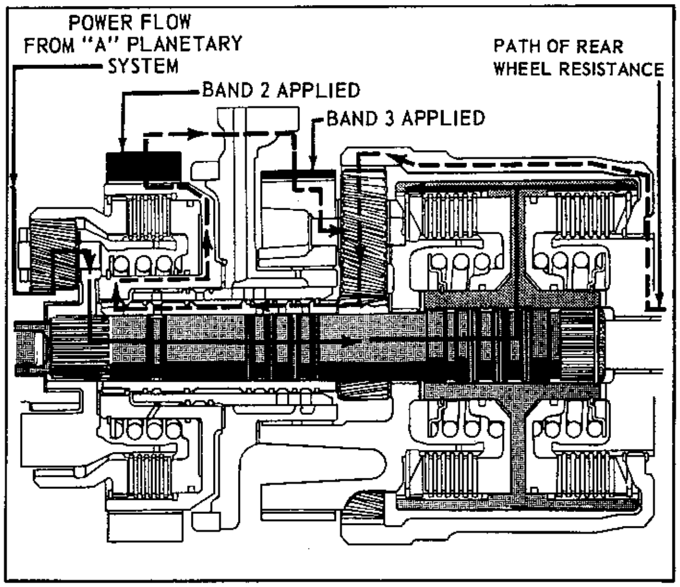


Figure 5
Power Flow – Park Position

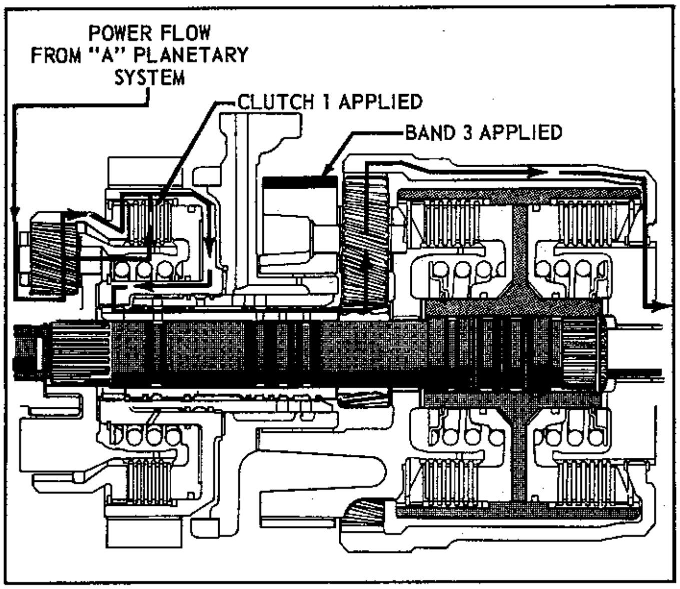


Figure 6
Power Flow – R_1 and R_2 Speed Ratios

others linked together by the clutch packs, the flow of power through the transmission provides ten forward speed ratios and two reverse speed ratios. All of the basic power flows are illustrated and described in this section. A chart illustrating the application of the bands and clutch packs for each gear ratio is shown in Figure 3.

A. Direct Drive and Overdrive

The power flow through the "A" planetary system, shown in Figure 4, is always the same. The carrier is splined to the transmission input shaft and power is taken out at the ring gear. The only function of the "A" planetary system is to transmit power from the engine to the "B" planetary system either at engine speed, for a direct drive condition, or at an increased speed, providing an overdrive condition. When the direct drive clutch is applied it locks the sun gear to the carrier and the "A" planetary system rotates as a unit at engine speed. When band 1 is applied to hold the sun gear, the direct drive clutch automatically releases and the rate of rotation increases as power is taken out at the ring gear.

B. Final Reduction

The "D" planetary system, shown in Figure 4, is always used to reduce the high speeds developed within the transmission to the required operating speeds and deliver the flow of power through the output shaft. The power will always enter the "D" planetary at the sun gear and go out through the carrier which is integral with the output shaft.

C. Primary Variable Reduction

The six basic speed ratios, five forward and one reverse, are obtained through the various combinations of holding or driving elements in the "B" and "C" planetary systems only. Therefore, ten forward speeds and two reverse speeds are made possible by the dual range characteristics of the "A" planetary system.

1. POWER FLOW – PARK POSITION

To provide the park position, which prevents any movement of the tractor, band 2 is applied to hold the "B" ring gear and "C" sun gear, and band 3 is also applied to hold the "C" carrier, as shown in Figure 5. With the "B" sun gear turning clockwise, the pinions "walk" around the "B" ring gear causing the "B" carrier, mainshaft, and housing for clutches 2 and 3, to rotate. Since neither clutch 2 nor clutch 3 is engaged, power is not transmitted to the "D" sun gear. Since "C" carrier is being held stationary by band 3 and the "C" sun gear is being held by band 2, the "C" planetary system is locked and will prevent the rear wheels from turning.

2. POWER FLOW – REVERSE SPEED RATIOS

The basic reverse speed ratio is obtained with the direct drive clutch applied, applying band 3 to hold the "C" carrier, and linking the "B" carrier to "B" ring gear with clutch 1, as shown in Figure 6. Rotation of the "B" sun gear causes the "B" planetary system to turn clockwise as an assembly. The "C" sun gear is, there-

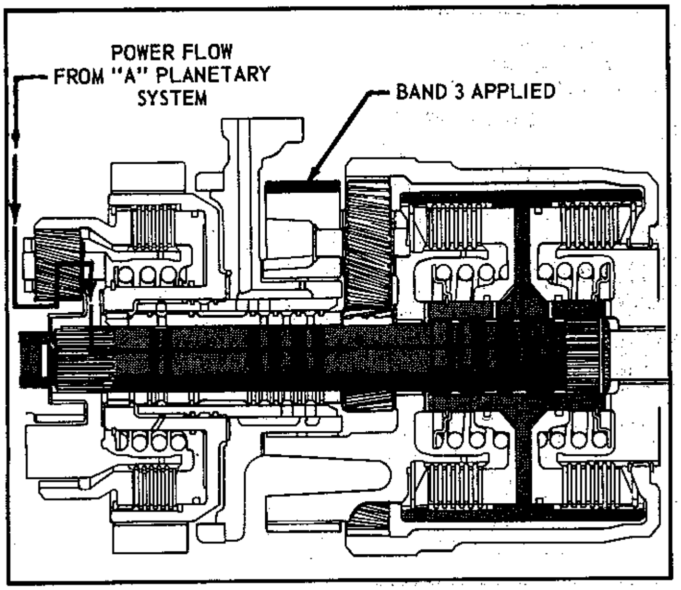


Figure 7
Power Flow – Neutral

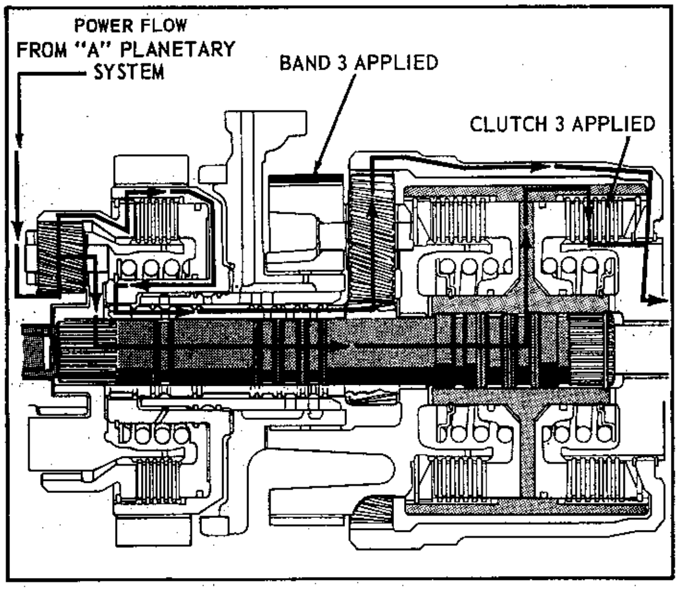


Figure 8
Power Flow – First and Third Speed Ratios

fore, driven clockwise resulting in the counterclockwise rotation of the "C" ring gear and "D" sun gear, which drives the "D" carrier and output shaft counterclockwise.

Reverse 2, being the overdrive ratio of reverse 1, is obtained by the application of band 1.

3. POWER FLOW – NEUTRAL

When the transmission is in neutral, only band 3 is applied to hold the "C" carrier, as shown in Figure 7. The clockwise rotation of the "B" sun gear causes the pinions to "walk" within the "B" ring gear, resulting in the rotation of the "B" carrier, mainshaft, and the housing for clutches 2 and 3. Since neither clutch is engaged, power is not transmitted to the "D" sun gear. The rear wheels are now free to turn as the "B" ring gear can rotate around the pinions.

4. POWER FLOW – FIRST AND THIRD SPEED RATIOS

The basic ratio is obtained with the direct drive clutch applied, holding the "C" carrier with band 3 and linking the "B" carrier to the "D" sun gear with clutch 3, as shown in Figure 8. This combination mechanically links both the "B" carrier and the "B" ring gear to the output shaft and results in a divided power flow. With the "B" sun gear turning clockwise, the "B" pinions will revolve counterclockwise and initiate the divided power flow to the "C" ring gear. On one side of the divided power flow, the "B" pinions spend a part of their rotation to "walk" clockwise around the inside of the "B" ring gear and thereby drive the "B" carrier, mainshaft, clutch 3, and "D" sun gear in a clockwise direction. On the other side of the divided power flow, the "B" pinions spend a part of their rotation to drive the "B" ring gear and the "C" sun gear in a counterclockwise direction. The "C" sun gear drives the "C" pinions which cannot orbit the central axis because band 3 is holding their carrier. Therefore, the "C" pinions rotate clockwise on their own axes and drive the "C" ring gear and the "D" sun gear in the same direction. Thus, two distinct drives are established between the "B" pinions and the "C" ring gear. This type of drive permits a high reduction ratio. Third speed, being the overdrive ratio of first, is obtained by the application of band 1.

5. POWER FLOW – SECOND AND FOURTH SPEED RATIOS

The basic speed ratio is obtained with the direct drive clutch applied, holding the "C" carrier with band 3 and linking the "B" carrier to "C" carrier with clutch 2, as shown in Figure 9. With both the "C" carrier and the "B" carrier being held, neither the "C" pinions nor the "B" pinions can orbit the central axis. Clockwise rotation of the "B" sun gear causes the "B" pinions to rotate on fixed axes driving the "B" ring gear and "C" sun gear in a counterclockwise direction. The "C" sun gear causes the "C" pinions to rotate on fixed axes, driving the "C" ring gear and "D" sun gear in a clockwise direction.

Fourth speed, being the overdrive ratio of second, is obtained by the application of band 1.

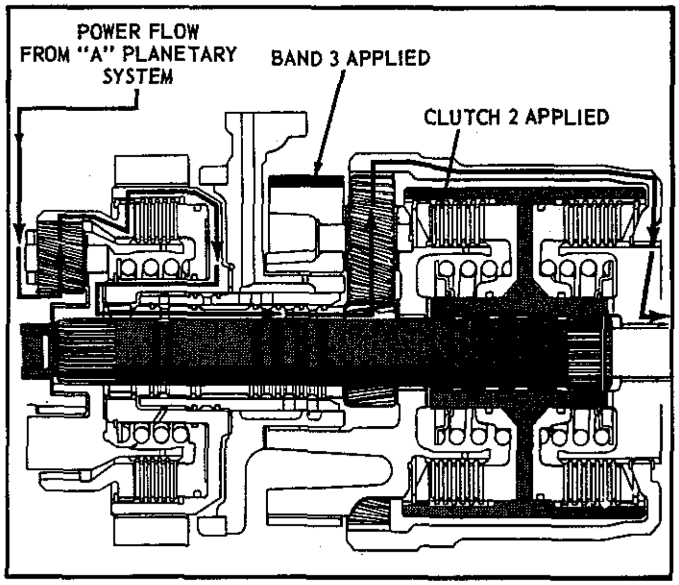


Figure 9
Power Flow – Second and Fourth Speed Ratios

6. POWER FLOW – FIFTH AND SEVENTH SPEED RATIOS

The basic speed ratio is obtained with the direct drive clutch applied, holding the "B" ring gear with band 2 and linking the "B" carrier to "D" sun gear with clutch 3, as shown in Figure 10. With band 2 holding the "B" ring gear, the clockwise rotation of the "B" sun gear causes the pinions to "walk" around the ring gear and drive the "B" carrier, mainshaft, and "D" sun gear in a clockwise direction.

Seventh speed, being the overdrive of fifth, is obtained by the application of band 1.

7. POWER FLOW – SIXTH AND EIGHTH SPEED RATIOS

The basic speed ratio is obtained with the direct drive clutch applied, holding the "B" ring gear and "C" sun gear with band 2, and linking the "B" carrier to "C" carrier with clutch 2, as shown in Figure 11. With band 2 holding the "B" ring gear, the clockwise rotation of the "B" sun gear causes the pinions to "walk" within the ring gear, driving the "B" carrier, mainshaft, and "C" carrier in a clockwise direction. Since the "C" sun gear is also being held, the pinions "walk" around the sun gear driving the "C" ring gear and "D" sun gear in a clockwise direction.

Eighth speed, being the overdrive of sixth, is obtained by the application of band 1.

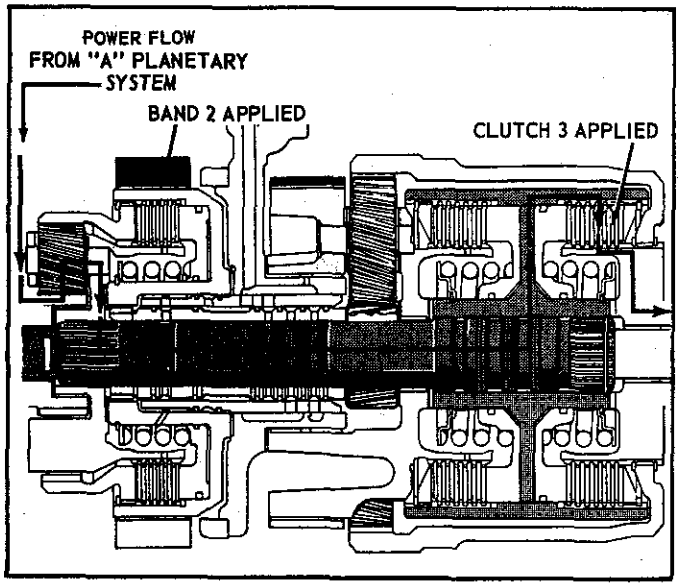


Figure 10
Power Flow – Fifth and Seventh Speed Ratios

8. POWER FLOW–NINTH AND TENTH SPEED RATIOS

The basic speed ratio is obtained with the direct drive clutch applied, linking the "B" carrier to "B" ring gear with clutch 1, and linking the "B" carrier to "C" carrier with clutch 2, as shown in Figure 12. As the "B" sun gear rotates clockwise, the complete "B" planetary system turns as an assembly, driving the mainshaft, "C" sun gear and "C" carrier at the same speed. This results in the "C" planetary system rotating as an assembly with the "C" ring gear driving the "D" sun gear clockwise at the same speed.

Tenth speed, being the overdrive of ninth, is obtained by the application of band 1.

HYDRAULIC CONTROL SYSTEM

A. Reservoir

The hydraulic fluid reservoir for this system is the transmission case which has a capacity of 11.5 quarts. The fluid pumped from the reservoir passes through a 40-mesh strainer screen which is easily removed for servicing. A plug on the bottom of the case drains the transmission.

B. Pump

The pump, shown in Figure 1, is a roller vane type which supplies fluid pressure through the main pressure tube to the pressure port in the distributor. The pump, driven by

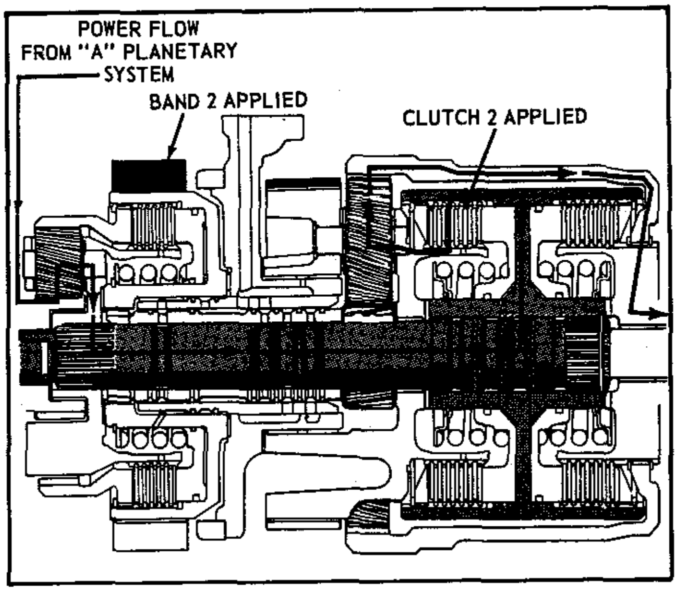


Figure 11
Power Flow – Sixth and Eighth Speed Ratios

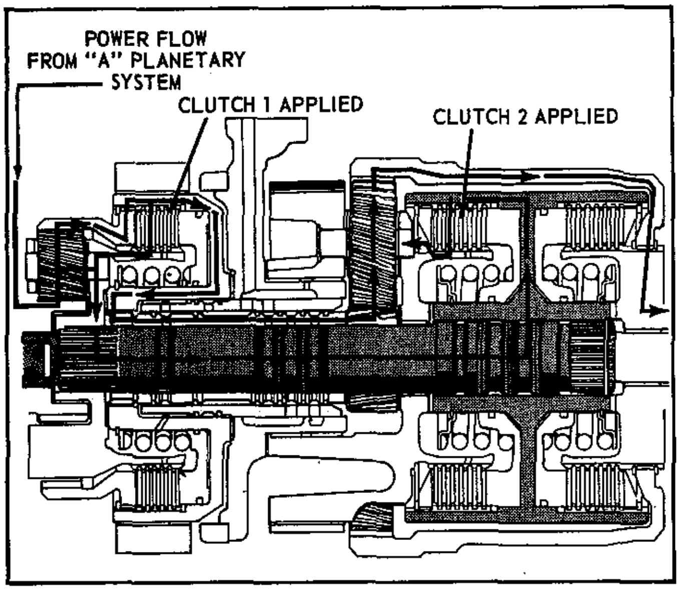


Figure 12
Power Flow – Ninth and Tenth Speed Ratios

the transmission input shaft, operates whenever the engine is running and will supply a sufficient quantity of fluid to maintain the required operating pressure and lubricate the entire transmission system.

C. Distributor

The distributor is co-axially mounted on the transmission mainshaft and is secured to the center web of the transmission case, as shown in Figure 1. The distributor acts as bearing journals for the clutch 1 and "C" carrier assemblies. Further, it channels the fluid to and from the control valve assembly for all servos and clutch packs with the exception of the direct drive clutch. The main pressure tube connects the pressure side of the pump to a port in the front of the distributor. The control valve mounts directly on the distributor and all the fluid that is directed by the control valve to the clutch packs or band servos flows through ports in the top of the distributor to the following areas:

Cast iron sealing rings on the front distributor journal clutch 1.

Ports on the left side of the distributor for the interlock cover and servos 2 and 3. See Figure 49.

Ports in the distributor bore which align with sealing ring channels on the "C" sun gear and mainshaft for lubrication and clutches 2 and 3.

Ports in the front of the distributor for servo 1 and the P.T.O. clutch.

A third port in the front of the distributor is directly connected to the main pressure port for direct drive clutch operation.

D. Control Valve Assembly

The control valve assembly is mounted directly on top of the distributor, as shown in Figures 1 and 14, and consists of upper and lower body assemblies. The control valve is actuated by a flexible cable coming from the selector assembly which rotates the cable wheel and camshaft assembly attached to the valve upper body. See Figure 14. Six cam followers operate the six spool valves in the lower body which control the fluid flow to three clutch pistons and three band servos. A safety switch mounted on the control valve permits the tractor engine to be started only when the selector lever is in the park (P) position. This switch is actuated by the camshaft assembly. As the selector is moved to park (P), the cam closes the switch completing the circuit to the tractor starter switch. Four adjustable spring-loaded, plunger-type valves are incorporated in the valve upper body to control the system pressure, lube pressure, and regulate or sequence oil flow first to the direct circuit. In addition, in the valve lower body, feathering valves are incorporated to control the oil flow in the transmission and P.T.O. indirect circuits. All of the valve components are shown in Figures 77 and 78.

The control valve separates the hydraulic system into the following direct and indirect circuits. See Figure 13.

Direct Transmission Circuit: Servos 1, 2, and 3, and the direct drive clutch with their respective spool valves,

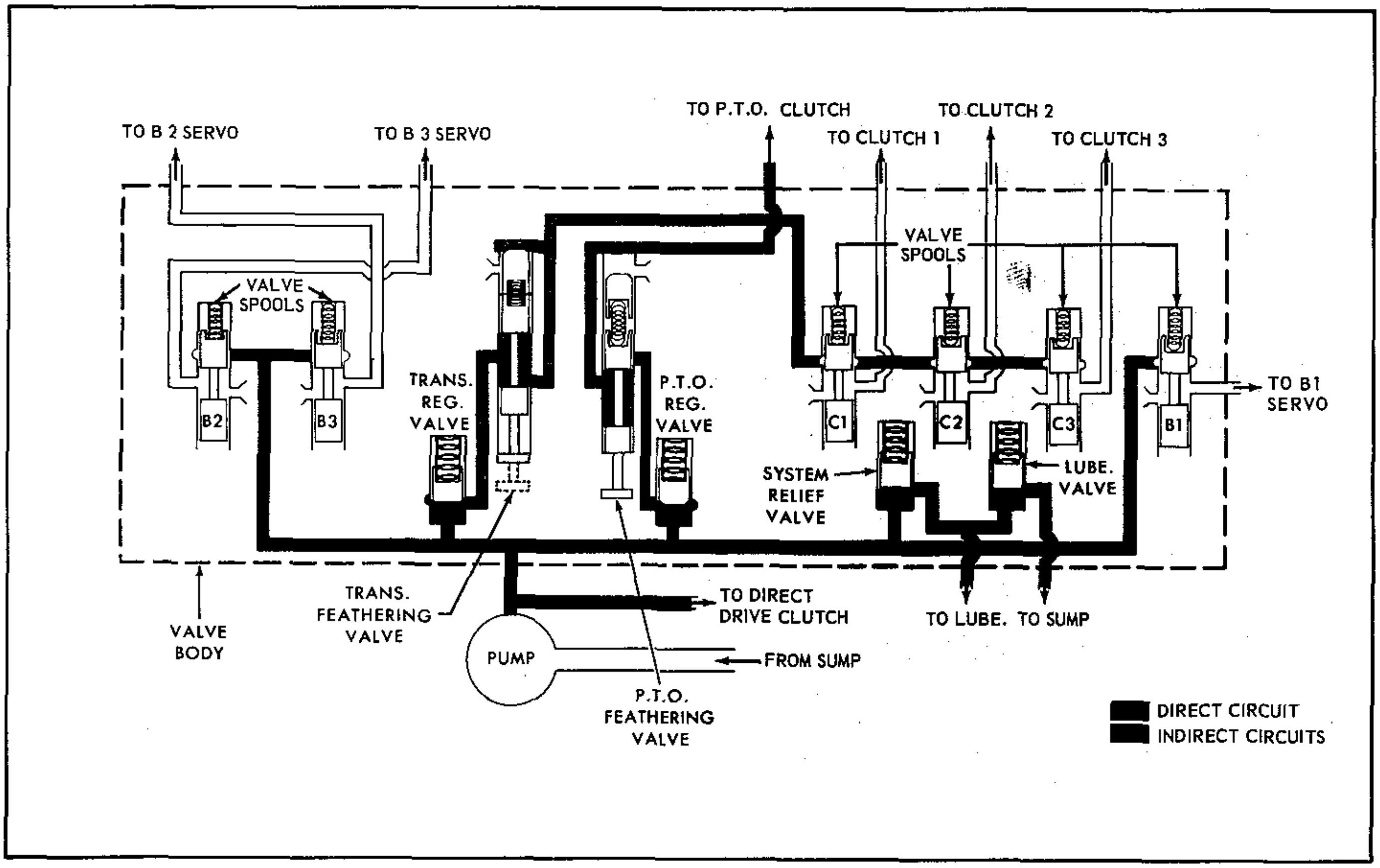


Figure 13
Control Valve Components and Circuits

are in a direct circuit with the pump.

Indirect Transmission Circuit: Clutches 1, 2, and 3, are in an indirect circuit with the pump, as their respective spool valves are separated from the pump by the transmission regulating and feathering valves.

Indirect P.T.O. Circuit: The P.T.O. clutch is in an indirect circuit with the pump, as it is separated from the pump by the P.T.O. regulating and feathering valves.

Indirect Lubrication Circuit: The transmission lubrication circuit is separated from the pump by the system relief valve.

The operation of the valve components is as follows:

System Relief Valve: The necessary operating pressure required in this system is regulated by a system relief valve located in the valve upper body. The valve is set to maintain 180 psi at an engine speed of 800 rpm.

Lubrication Relief Valve: The lubrication relief valve is located in the upper valve body. After the system pressure of 180 psi is attained, the excess fluid passes over the system relief valve to the lubrication relief valve. The lubrication valve is set to maintain 43 psi in the lubrication circuit. All of the fluid bypassing the lubrication relief valve is returned directly to sump through a filter and tube assembly.

The lube circuit consists of lube passages in the distributor and transmission main shaft. Lubrication is accomplished by controlled bleeding along the mainshaft. The rear support and "D" carrier receive lube oil through an orifice at the end of the lube passage in the mainshaft. A sender switch located in the rear support controls the lubrication warning lamp on the instrument panel at any time a low lube pressure condition exists. The sender switch closes the circuit whenever the pressure in the rear support is less than 2 psi.

Since the lubrication system is not pressurized until system pressure is attained, the lubrication warning lamp will flash on when the tractor is started and whenever the P.T.O. or transmission feathering valves are used. This drop in lube pressure is not detrimental for short periods of time as sufficient oil is available in the circuit for lubrication purposes.

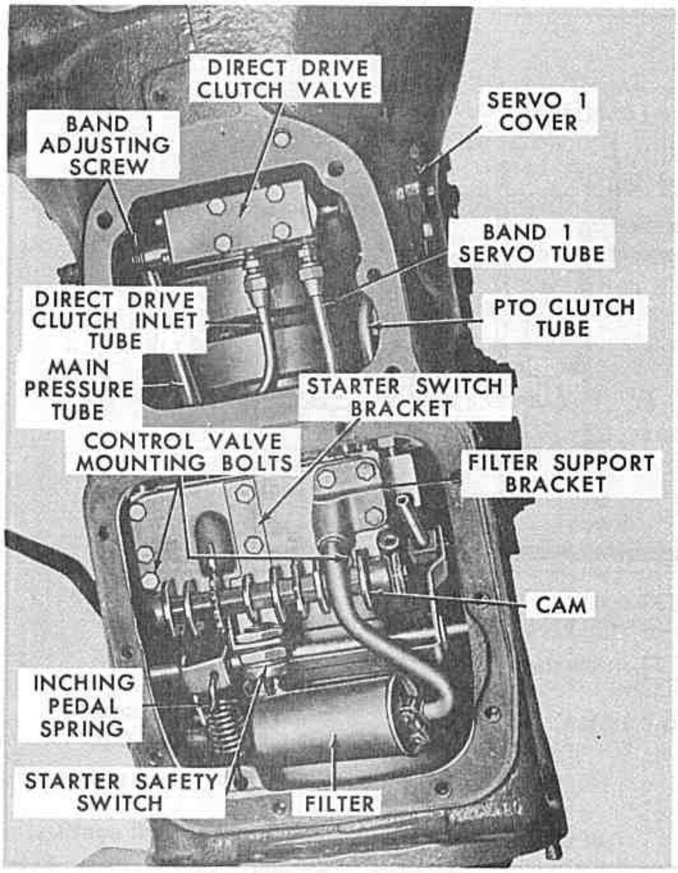


Figure 14
Transmission Cover Removed

Regulating Valves: Two regulating valves are located in the valve upper body. One is in the indirect transmission circuit containing the spool valves for clutches 1, 2, and 3. The other is in the P.T.O. clutch circuit. These valves are set at 150 psi, and operate as follows:

1. As pressure within the direct circuit is building up to 180 psi, both regulating valves remain closed and allow all of the fluid to be first directed to the servos. This eliminates the possibility of a temporary locked condition in the transmission during the gear ratio changes since the combination of bands 2 and 3 both applied is used in park (P). This arrangement also permits smoother shifting characteristics.
2. When the pressurized fluid in either the indirect transmission circuit or the indirect P.T.O. circuit is partially relieved by the action of either feathering valve, system pressure will tend to drop below the regulating valve's setting of 150 psi. To maintain sufficient pressure in the direct circuit and the transmission or P.T.O. indirect circuit, whichever is not being relieved, the regulating valves function as check valves to permit the servos and/or clutches in the unaffected circuits to operate satisfactorily.

Transmission Feathering Valve: The transmission inching pedal is located on the left side of the transmission case. It is used to maneuver the tractor very slowly or slightly, as required, when hitching or unhitching implements, and as a means of interrupting the power flow to the rear wheels. This pedal actuates a feathering valve located in the control valve lower body.

The feathering valve is located in the transmission indirect circuit ahead of the spool valves which control the fluid flow to clutches 1, 2, and 3. During normal operation, the feathering valve directs all of the fluid to the clutches, as shown at (A), Figure 15. When the pedal is completely depressed, fluid pressure is released from the clutch packs in the indirect circuit and engine power will not be transmitted to the rear wheels. This position of the feathering valve is shown at (C), Figure 15. When the pedal is raised slowly from the depressed position, fluid pressure will gradually increase and the elements in the indirect circuit will begin to engage. This is the "feathering" position of the valve, and is shown at "B", Figure 15.

P.T.O. Feathering Valve: In the P.T.O. model transmissions, the P.T.O. feathering valve is actuated by a "T" handle and rod assembly mounted in the right side of the tractor hood. The P.T.O. feathering valve, located in the control valve lower body, directs and controls the fluid pressure in the P.T.O. indirect circuit. When the handle is slowly pulled out, the feathering valve will move further into the control valve body. As the valve moves into the body, it opens a pressure port allowing fluid into the passage to the P.T.O. clutch. This fluid will at first be free to pass to sump. This position of the valve is shown at (B), Figure 15. As the valve continues to travel inward, the passage to sump will gradually be closed and increasing fluid pressure will be exerted on the P.T.O. clutch piston, causing the clutch to gradually engage. This position of the valve is shown at (A), Figure 15. This will facilitate the gradual starting of P.T.O.–operated equipment. When the feathering valve is in the extreme "OUT" position, with the control handle forward, the fluid pressure is entirely excluded from the P.T.O. circuit and the fluid in the P.T.O. clutch will be forced to return to sump by action of the P.T.O. piston return spring. The clutch will then be disengaged. This position of the valve is shown at (C), Figure 15.

Valve Spools: Six interchangeable spring-loaded, off-and-on valve spools direct fluid pressure to three clutch packs in the indirect circuit and the three servos. The spools are located in the control valve lower body and are controlled by the six cam followers. As combinations of valve spools are moved into the control valve body, fluid pres-

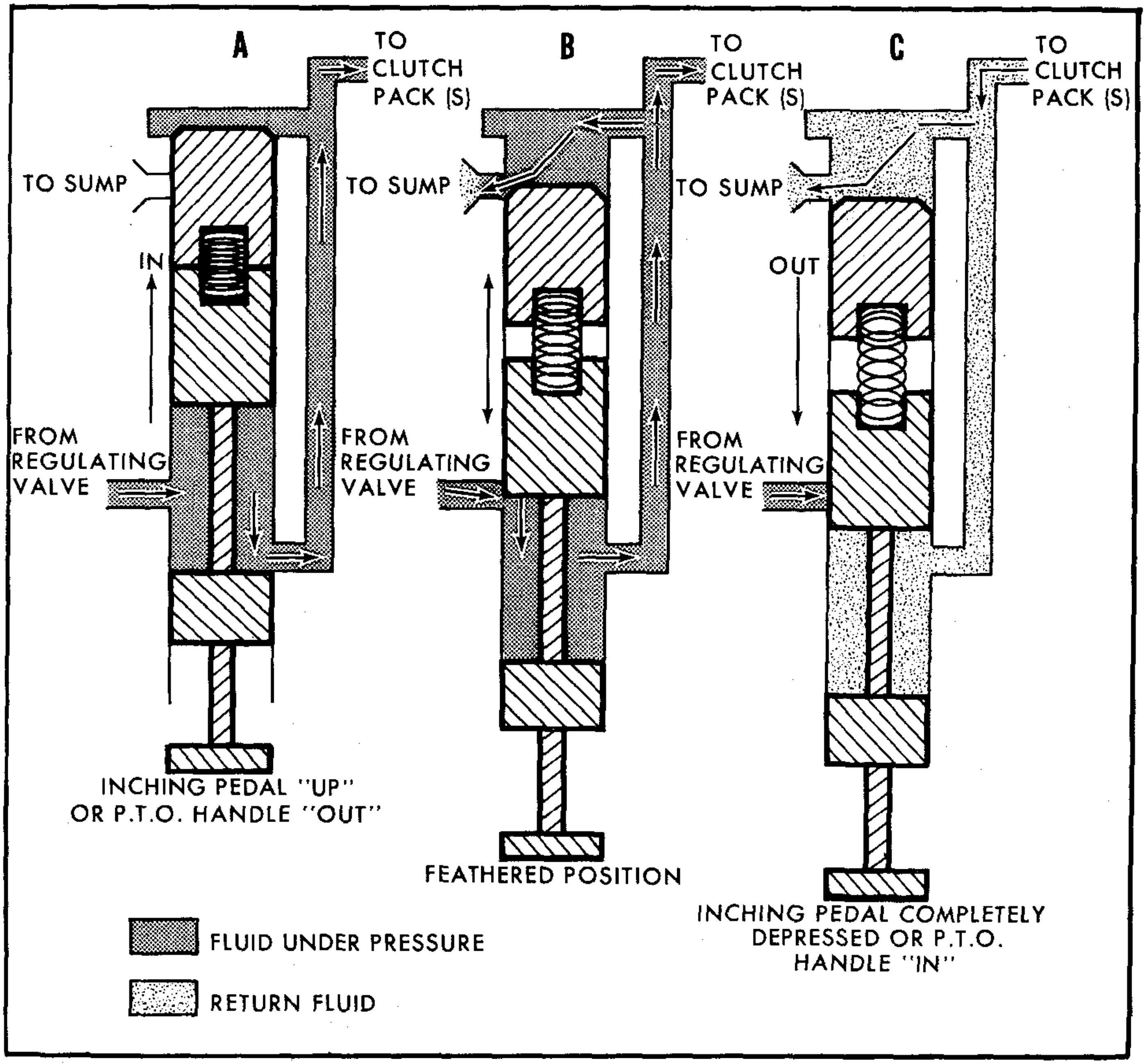


Figure 15
Feathering Valve Operation

sure is directed to the specific clutch pistons, and/or band servos to obtain the various speed ratios. Refer to Figure 13. When the force is removed from the cam follower, the spool automatically returns to the "OUT" position by spring action, and the clutch pack or band servo fluid is dumped to sump through the return ports in the valve body.

E. Direct Drive Clutch Valve

The direct drive clutch pack locks together the "A" sun gear to the "A" carrier, resulting in the "A" planetary gear set rotating as an assembly for direct drive gear ratios. Since band 1 is used to hold the "A" sun gear for the overdrive ratios, it is essential that both band 1 and the direct drive clutch are not simultaneously applied; otherwise, a lock-up condition would occur in the "A" planetary system. For this reason the fluid flow to the direct drive clutch pack is controlled by a hydraulic interlock arrangement. The interlock or direct drive clutch valve, as shown in Figures 14 and 16, is located in the servo 1 opening in the inside of the transmission case. Direct drive clutch valve actuation is therefore directly

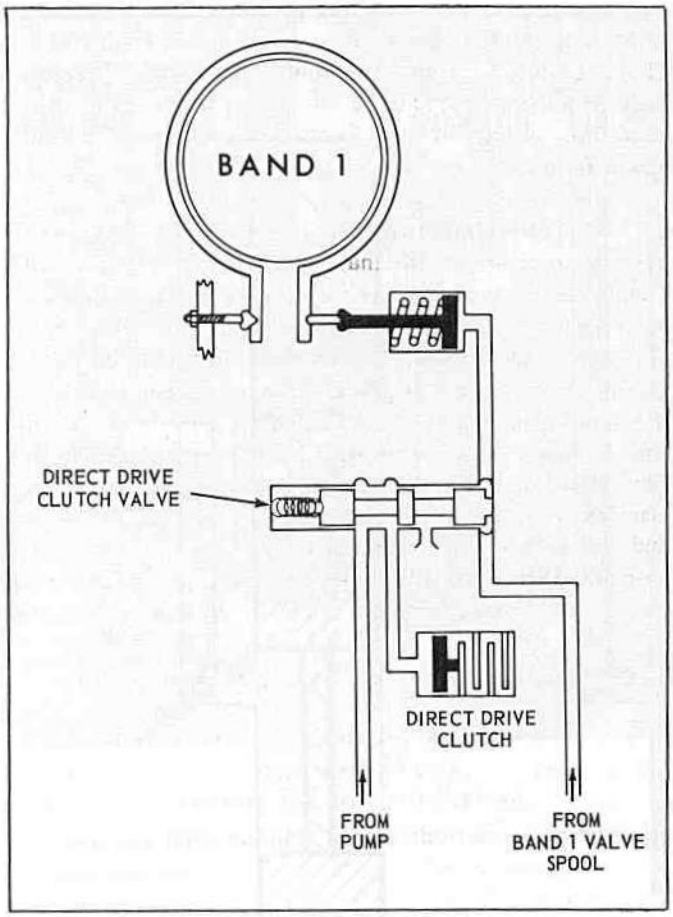


Figure 16
Direct Drive Clutch and Valve

determined by the position of the band 1 spool valve, which controls the fluid flow to servo 1.

Direct Drive Gear Ratios: In the direct drive gear ratios, pump fluid flows to the direct drive clutch pack without entering the control valve, Figure 16. A passage and opening in the distributor leading off the main pressure passage permits pump fluid to flow through tubing to the direct drive clutch valve and on to the front adapter plate. A passage in the adapter plate directs the fluid to a drilled passage in the transmission input shaft. Cast iron shaft sealing rings are used on the input shaft at both the direct drive clutch and adapter plate locations to seal the fluid flow. See Figure 1.

Overdrive Gear Ratios: When an overdrive gear ratio is selected, band 1 valve spool is mechanically moved to the open position and control valve fluid flows directly to band 1 servo to apply the band. The fluid that flows to servo 1, however, first passes through one end of the direct drive clutch valve exerting pressure against the end of the spool. This causes the spool to be shuttled or forced to the left, shutting off the fluid flow to the direct drive clutch pack. The clutch pack fluid is then dumped to sump through the port in the direct drive clutch valve. Whenever a direct drive gear ratio is selected, servo 1 fluid is dumped to sump and the force exerted by the direct drive clutch valve return spring moves the spool to the right, opening up the direct drive clutch passage.

F. Filter Assembly

The filter assembly, shown in Figure 14, will remove foreign material that is carried in suspension in the transmission fluid. The filter element is a replaceable pleated paper type with a pressure relief valve located in the filter inlet set at 7 to 9 psi to permit the filter to bypass fluid if the element becomes clogged. The filter element is to be replaced after the first 50 hours and every 1200 hours thereafter.

G. Interlock Assembly

The cover assembly for servos 2 and 3, located on the left side of the transmission, as shown in Figure 17, incorporates a hydraulic interlock which functions to prevent bands 2 and 3 from being applied simultaneously when shifting between fourth and fifth speeds. The fluid flow from these servos must be controlled as the application of both bands will cause a braking action as bands 2 and 3 are applied in park (P).

Fluid pressure directed to either servo 2 or servo 3 travels from the distributor into passages in the servo 2 and 3 cover. Valves located in the passages as shown in Figure 18, are mechanically linked to the piston of the opposite servo.

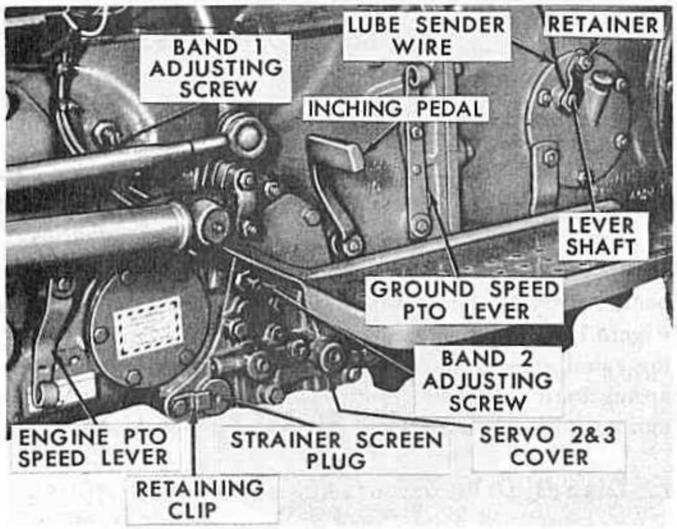


Figure 17
Left Side of Transmission

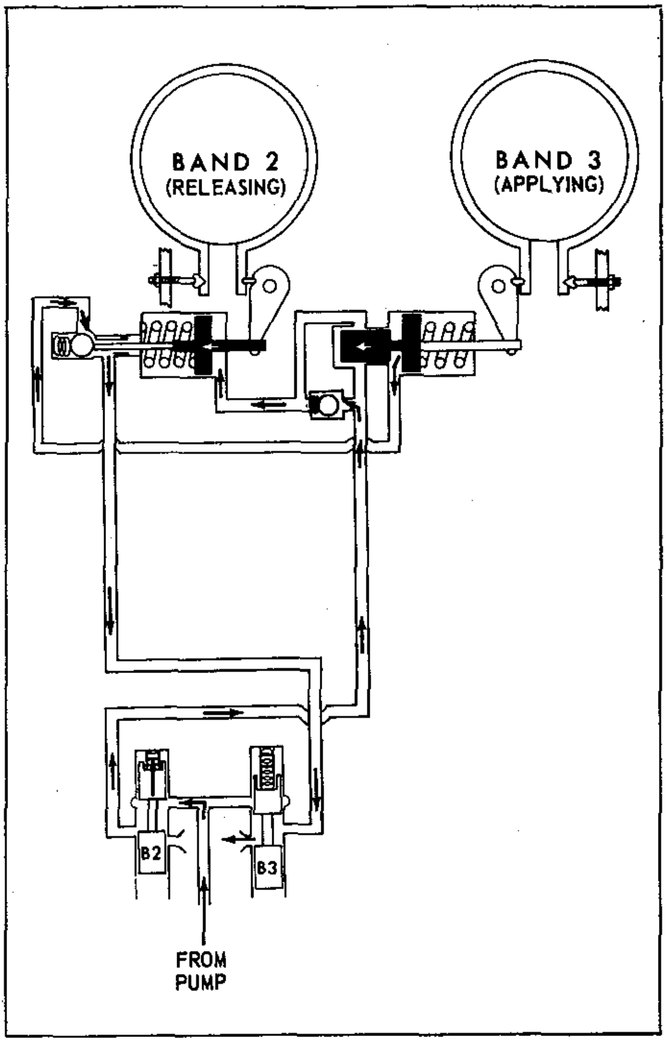


Figure 18
Hydraulic Interlock in Servo 2 and 3 Cover

When shift from fourth to fifth speed is made, band 3, which has been mechanically applied, must be hydraulically released and band 2 must mechanically apply. As the fluid pressure directed to servo 3 acts on the piston and compresses the springs, the valve attached to the piston is withdrawn from its position, blocking the fluid passage to servo 2 in the cover. This permits the fluid from servo 2 to return to sump and allows the mechanical application of band 2. When shifting from fifth speed to fourth speed, the reverse action takes place and band 2 must be hydraulically released and band 3 must mechanically apply. As fluid pressure is directed to servo 2, the spring pressure is overcome and the piston and piston rod move outward toward the cover, releasing the band. At the same time the servo rod contacts the plunger which unseats the ball check valve located in the fluid passage to servo 3. Now the fluid in servo 3 is permitted to exhaust to sump and band 3 will be applied by spring pressure.

As shown in Figure 18, fluid pressure directed to either servo will quickly unseat the ball check valve in its path. Thus, the interlock assembly only functions to "control" fluid return to sump, thereby preventing a possible lock-up condition when changing between the fourth and fifth speed ratios.

The transmission always goes to park (P) whenever the system pressure is eliminated. When this occurs, bands 2 and 3 apply gradually as metering orifices at the check valves permit the fluid to bleed out under the return spring pressure of the servos. The orifice through which fluid is metered from servo 2 is the clearance between the O.D. of the spool attached to servo 3, and its bore in the servo 2 and 3 cover. The metering orifice controlling the fluid from servo 3 is the clearance between the O.D. of the smallest diameter of the interlock valve seat for servo 3 and the bore in the interlock cover in which the seat is pressed. Figure 92 illustrates the valve seat. Both clearances are closely held to maintain controlled bleeding.

H. Hydraulic Control System Operation

Proper transmission operation is determined by the hydraulic control system which controls the flow of fluid pressure to the clutch packs and servos. The details of the fluid action to actuate these components for each gear ratio are given below. Figure 19 illustrates in schematic form the hydraulic system for the park (P) position.

Park Position: When the selector lever is in park (P), the six valve spools in the control valve lower body are in the "OFF" position and there is no delivery of fluid pressure, past the control valve assembly other than lubrication. The direct drive clutch shuttle valve spool is moved to the right by the return spring and pump pressure is directed to apply the direct drive clutch. Bands 2 and 3 remain mechanically applied to hold the "C" planetary system and prevent any movement of the rear wheels.

Reverse Speed Ratios: In the basic reverse speed ratio (R_1), the direct drive clutch shuttle valve spool is moved to the right by the return spring and pump pressure is directed to apply the direct drive clutch. The valve spools B2 and C1 are moved inward and fluid pressure is directed to apply clutch 1 and release band 2. Band 3 remains mechanically applied. The overdrive reverse ratio (R_2) is obtained when valve spool B1 is also moved inward to open the passage from the control valve to the direct drive clutch valve and servo 1. This permits servo 1 fluid pressure to move the direct drive clutch shuttle valve spool to the left, closing the passage to the direct drive clutch while at the same time applying band 1.

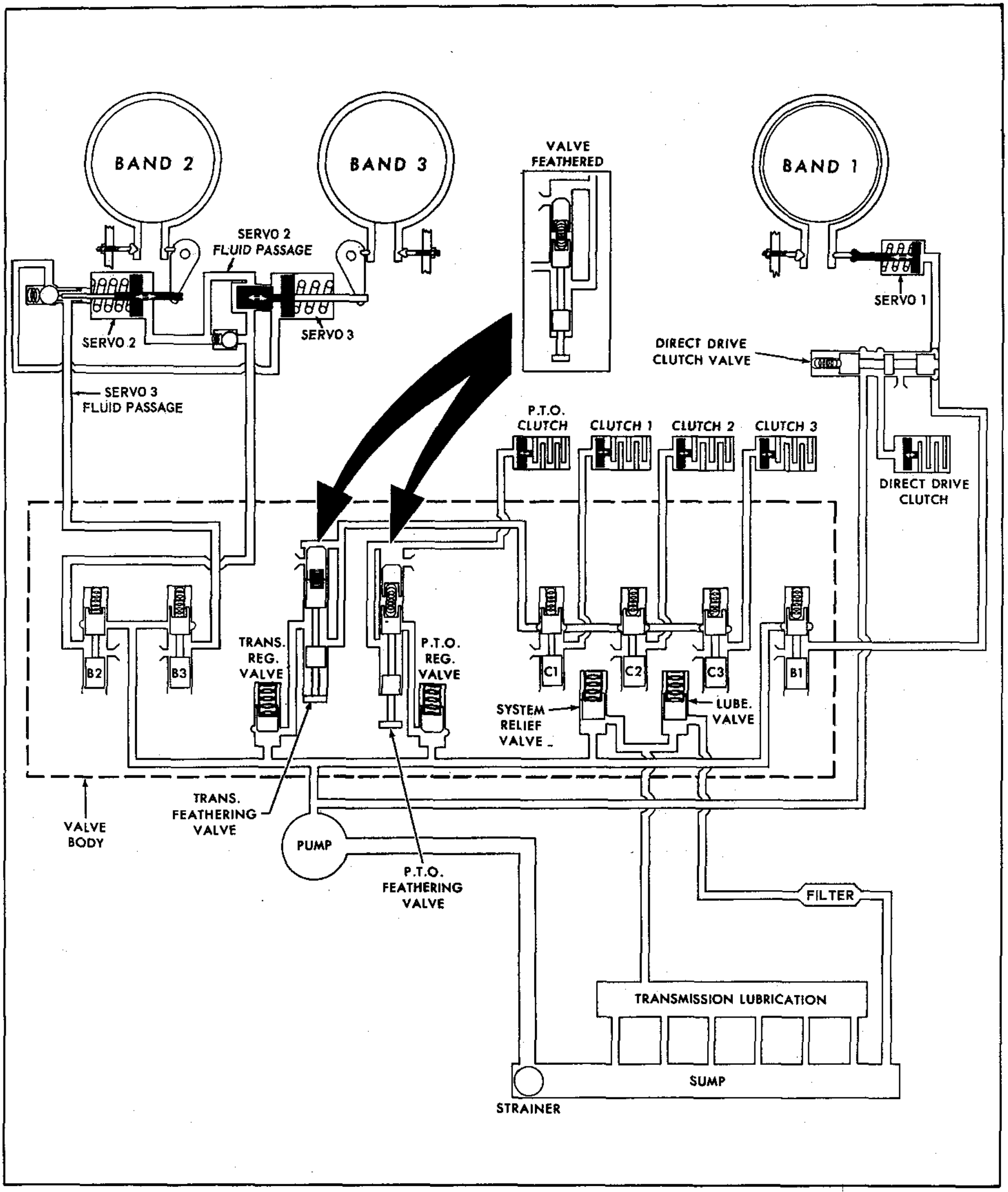


Figure 19
Transmission Circuits

Neutral: In the neutral position, the direct drive clutch shuttle valve spool is positioned to the right by the return spring and pump pressure is directed to apply the direct drive clutch. The valve spool B2 is moved inward and fluid pressure is directed to servo 2, hydraulically releasing band 2. With only band 3 mechanically applied, power *cannot be transmitted to the rear wheels;* however, the tractor is free to roll forward or backward.

First and Third Speed Ratios: *In the first speed ratio,* the direct drive clutch shuttle valve spool is positioned to the right by the return spring and pump pressure is directed to apply the direct drive clutch. The valve spools B2 and C3, which control the fluid passages to servo 2 and clutch 3 are moved inward. Hydraulic pressure releases band 2 and applies clutch 3 which, combined with band 3, being mechanically applied, gives this forward speed. The third speed ratio (overdrive of first speed) is obtained when valve spool B1 is also moved inward to open the passage from the control valve to the direct drive clutch valve and servo 1. This permits servo 1 fluid pressure to move the direct drive clutch shuttle valve spool to the left, closing the passage to the direct drive clutch while at the same time applying band 1.

Second and Fourth Speed Ratios: In the second speed ratio the direct drive clutch shuttle valve spool is positioned to the right by the return spring and pump pressure *is directed to apply the direct drive* clutch. The valve spools B2 and C2 are moved inward to permit hydraulic pressure to reach clutch 2 and servo 2. Band 2 is now hydraulically released. Clutch 2 is hydraulically engaged and band 3 is mechanically *applied to establish this* forward speed. The fourth speed ratio (overdrive of second speed) is obtained when valve spool B1 is also moved inward to open the passage from the control valve to the direct drive clutch valve and servo 1. This permits servo 1 fluid pressure to move the direct drive clutch shuttle valve spool to the left, closing the passage to the direct drive clutch while at the same time applying band 1.

Fifth and Seventh Speed Ratios: In the fifth speed ratio the valve spools B3 and C3 in the control valve lower body are moved inward to open the passages to clutch 3 and servo 3. Now, band 3 is hydraulically released and band 2 is mechanically applied to combine with clutch 3 and give this forward speed. The seventh speed ratio (overdrive of *fifth)* is obtained when valve spool B1 is also moved inward to open the passage from the control valve to the direct drive clutch valve and servo 1. This permits servo 1 fluid pressure to move the direct drive clutch shuttle valve spool *to the left, closing the passage* to the direct drive clutch while at the same time applying band 1.

Sixth and Eighth Speed Ratios: In the sixth speed ratio, the direct drive clutch shuttle valve spool is positioned to the right by the return spring and pump pressure is directed to apply the direct drive clutch. The spool valves B3 and C2 which control the passages to servo 3 and clutch 2 are moved inward. Band 3 is hydraulically released, clutch 2 is hydraulically applied, and band 2 is mechanically applied to combine with clutch 2 and give this forward speed. The seventh speed ratio (overdrive of fifth) is obtained when valve spool B1 is also moved *inward to open the passage from the control valve to the* direct drive clutch valve and servo 1. This permits servo 1 fluid pressure to move the direct drive clutch shuttle valve spool to the left, closing the passage to the direct drive clutch while at the same time applying band 1.

Ninth and Tenth Speed Ratios: In the ninth speed ratio, the direct drive clutch shuttle valve spool is positioned to the right by the return spring and pump pressure is directed to apply the direct drive clutch. The valve spools B2, B3, C1, and C2, are moved inward, allowing hydraulic pressure to actuate servos 2 and 3, and clutches 1 and 2. With bands 2 and 3 hydraulically released, this forward speed is obtained by the application of clutches 1 and 2. The tenth speed ratio (overdrive of ninth) is obtained when valve spool B1 is also moved inward to open the passage from the control valve to the direct drive clutch valve and servo 1. This permits servo 1 fluid pressure to move the direct drive clutch shuttle valve spool to the left, closing the passage to the direct drive clutch while at the same time applying band 1.

TRANSMISSION CONTROLS

A. Gear Ratio Selector Assembly

The selector assembly, shown in Figure 20, mechanically transmits the speed selections through a flexible cable to the control valve in the Select-O-Speed Transmission. A wheel attached to the camshaft on the control valve rotates as the selector extends or retracts the cable. The camshaft is accurately indexed for each transmission gear ratio by a detent which engages notches in a detent cam on the camshaft.

A selector indicator is fixed to and rotates with the selector lever shaft. The corresponding ground speeds in each gear ratio at 1200, 1750, and 2200 engine rpm are shown on the dial. A lamp is installed in the top of the selector assembly to illuminate the dial whenever the tractor key is "ON."

The selector assembly permits shuttle-type operation as

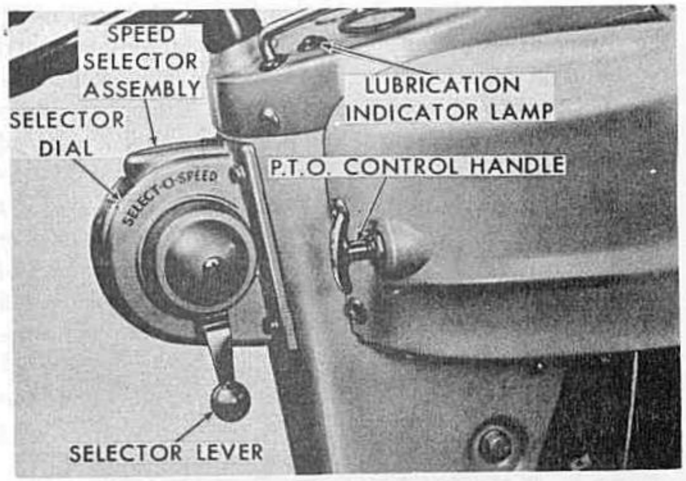


Figure 20
Speed Selector Assembly

screw stops can be installed in the R_1, R_2, 3rd, 5th, or 7th gear selections as desired. Refer to Figure 23. Also, a bypass shuttle plate is available to permit the selector lever to override the neutral notch. The selector lever and notched cover may be installed on either side of the assembly for right-hand or left-hand operation.

B. P.T.O. Control Assembly

The P.T.O. control assembly located on the right rear hood panel, shown in Figure 20, operates the P.T.O. clutch pack in the transmission. The control consists of a slider mechanism and T-handle attached to a flexible cable. The cable, which is enclosed in a conduit, is threaded into a slider assembly in the transmission cover. The slider, in turn, is linked to the feathering valve rocker assembly. When the T-handle is pulled out, the rocker contacts and forces the P.T.O. feathering valve spool into the control valve upper body. The handle mid-position is the feathering point which permits P.T.O. clutch slippage by bleeding oil to sump for easing into loads. In the full "OUT" position, the feathering valve directs all the P.T.O. clutch circuit fluid to apply the clutch pack.

C. Engine Speed P.T.O. Lever

In the two speed P.T.O. transmissions, either 540 or 1000 rpm A.S.A.E. standard P.T.O. speeds can be obtained at 1750 engine rpm. This is accomplished by a sliding coupling arrangement on the transmission input shaft, as shown in Figure 1. The engine speed P.T.O. shift lever, when in the forward position as illustrated in Figure 17, selects the 540 rpm speed by sliding the shifter collar rearward on the shaft which causes the rear input shaft gear to drive the clutch housing. The 1000 rpm speed is obtained by moving the lever to the rear and selecting the forward set of gears. A neutral, or middle, position disengages the gears and should be used when operating the tractor without P.T.O. equipment.

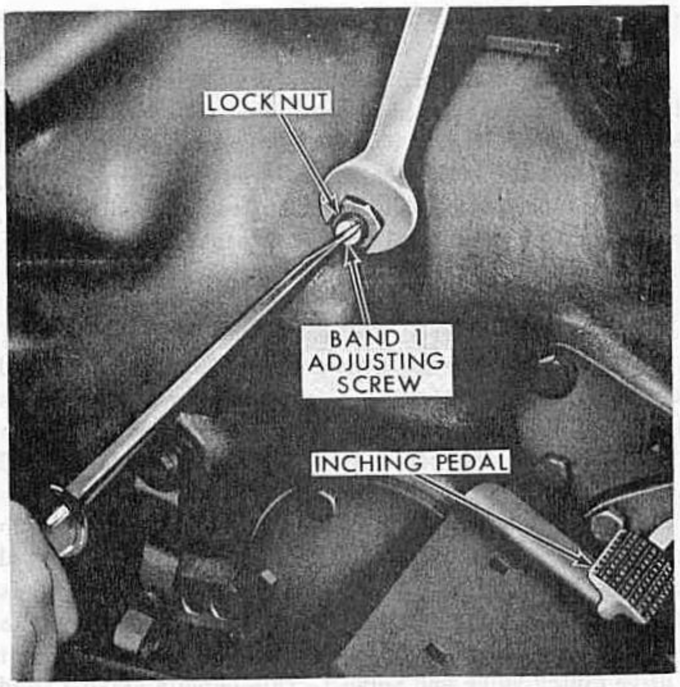


Figure 21
Loosening the Adjusting Screw Locknut

D. Ground Speed P.T.O. Lever

In the two speed P.T.O. transmissions, a P.T.O. speed relationship proportional to the tractor forward travel, is obtained by driving the P.T.O. shaft from the output side of the transmission. Figure 1 illustrates the P.T.O. drive gear mounted on the "D" carrier which is integral with the output shaft through a sliding coupling arrangement. The coupling is moved by a shifter fork connected to the ground speed level.

The lever illustrated in Figure 17 in the rearward position, disengages the coupling from the gear for standard P.T.O. operation.

An interlock arrangement, shown in Figure 30, prevents both engine and ground P.T.O. relationships from being engaged at the same time.

8. MAINTENANCE AND ADJUSTMENTS

The transmissions are filled at the factory with Ford Hydraulic Fluid, Specification M-2C-41. Always use this type fluid when adding or changing fluid, as the use of an improper or inferior product may affect the operation of the transmission.

MAINTENANCE

A. Transmission Fluid Level Check

The fluid level in the transmission should be checked during pre-delivery and at 50-hour intervals thereafter, using the following procedure.

1. Make certain that the tractor is level.
2. Shut off the tractor engine.
3. Clean the area surrounding the fluid level and filler plug, shown in Figure 22, and remove the plug.
4. Check to be sure that the fluid is up to the level of the filler plug opening. If necessary, add enough fluid through this opening to provide the proper level, and replace the plug.

B. Transmission Fluid and Filter Change

It is important that the transmission fluid and filter be changed at the 50-hour inspection and at 1200 hour intervals thereafter. It is also recommended that the fluid be changed whenever foreign material is found in, or is known to have entered the transmission. New fluid, Ford Specification M-2C-41, should always be used whenever the transmission has been disassembled for servicing.

The following procedure should be followed when changing the transmission hydraulic fluid. For filter removal refer to page 35.

1. Remove the drain plug from the bottom of the transmission case and drain the fluid into a suitable container.
2. Loosen the hex head bolt, shown in Figure 17, which secures the strainer screen plug in the interlock cover by means of a retaining clip.

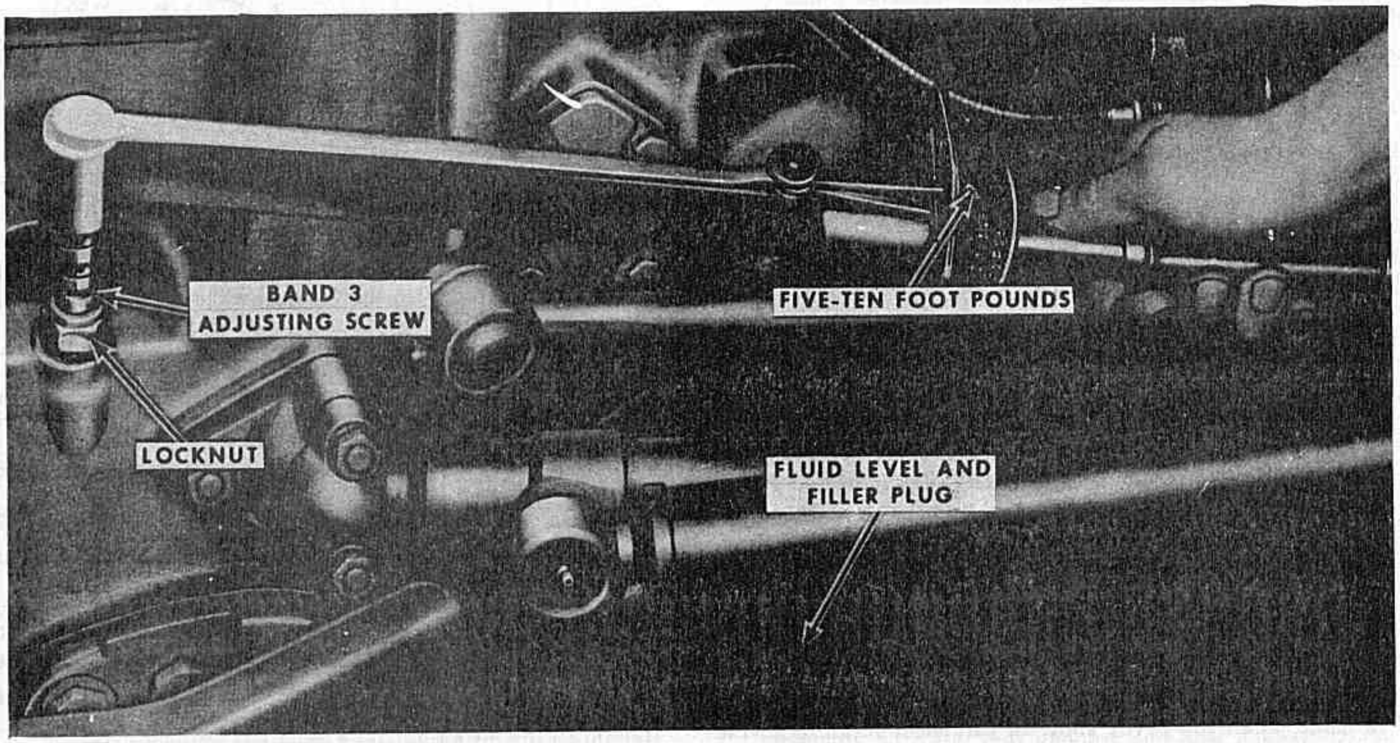


Figure 22
Adjusting the Bands

3. Remove the plug by pulling outward. Thoroughly clean the screen and discard the "O" ring.

   NOTE: *It may be necessary to thread a 1/4" – 20 bolt into the plug to provide a means of initially withdrawing this assembly.*

4. Place a new "O" ring on the plug, install the screen plug in the interlock cover with the hole to the top and secure with the retainer and hex head bolt.
5. Replace the drain plug in the bottom of the case.
6. Clean the area surrounding the fluid level and filler plug, Figure 22, then remove the plug and add 12 quarts of Ford Specification M-2C-41 Hydraulic Fluid to the transmission through this opening.

   NOTE: *If the transmission cover has been removed, the fluid can be easily poured through this larger opening.*

7. Replace the fluid level and filler plug. Run the engine at a fast idle speed to bring the fluid up to normal operating temperature.
8. With the traction coupling locked in the disengaged position, shift the selector lever through all speeds. Stop the engine and check the fluid level.

ADJUSTMENTS

A. Traction Coupling

The transmission output shaft incorporates a coupling sleeve which can be shifted to disengage the power from the differential pinion shaft. It will be necessary to disengage the traction coupling whenever the tractor is to be moved without the engine running as bands 2 and 3 mechanically apply to hold the rear wheels. ***It is also recommended that the traction coupling be disengaged and the retainer be in place and securely tightened*** before any servicing or adjusting of the transmission or of the complete tractor is undertaken with the engine running.

The traction coupling sleeve is manually disengaged by turning the lever shaft, shown in Figure 17, clockwise to move the splined sleeve forward on the transmission output shaft and away from the pinion shaft. Engagement is made when the lever shaft is turned counterclockwise which brings the coupling sleeve rearward to connect with the splined pinion shaft.

1. To turn the lever shaft, the retainer which is held in place by the nut and washer as shown in Figure 17, must be removed.
2. The retainer can be used as a handle to rotate the shaft in the desired direction. There are alternate positions for installing the retainer in the engaged or disengaged positions of the coupling sleeve.
3. If the retainer does not align properly, turn it both end for end and side for side.

B. Band Adjustments

The three brake bands should be adjusted during predelivery and again at the 50-hour inspection. Thereafter, the bands should be adjusted after each 600 hours of operation. Before adjusting the bands, make certain the fluid in the transmission is at the proper level. The bands are all adjusted in their released position as follows:

1. Disconnect the traction coupling making sure it is properly secured in the disengaged position.
2. Operate the tractor until the transmission reaches *normal operating temperature* (120° F.) and then adjust the throttle to obtain 800 engine rpm.
3. Refer to the chart and move the gear selector lever to apply the band. Hold the band adjusting screw as shown in Figure 21, and loosen the lock nut two full turns.
4. Referring to the chart, select the correct released gear ratio for the band involved. Tighten the adjusting screw to 5–10 ft. lbs. and back the screw off the proper number of turns. Refer to Figure 22. Band 1 is to be adjusted with the tractor engine "off."

Band	*Released Gear Ratio*	*Screw Torque (ft. lbs.)*	*Turns Backed Off*	*Applied GearRatio*
1	Engine Off	5–10	1	3rd
2	Neutral	5–10	3/4	Park
3	5th	5–10	3/4	Park

5. Select the gear ratio to apply the band involved and prevent the adjusting screw from turning. Tighten the lock nut to 20–25 ft. lbs. while holding the adjusting screw.

   NOTE: *Overtightening the lock nut will distort the copper sealing washer.*

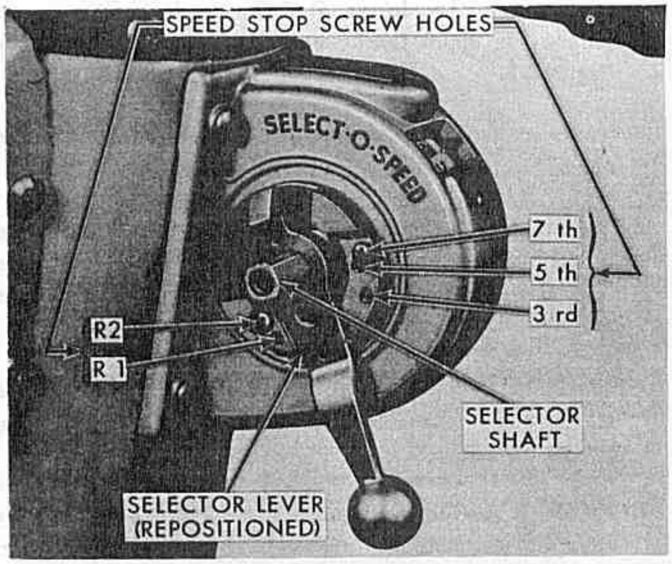


Figure 23
Repositioning the Selector Lever

C. Repositioning the Selector Lever

In the event it is more convenient for the operator to make the speed selections with his left hand rather than his right hand, the lever may be repositioned as follows:

1. Remove the notched cover and spring from the right end of the selector shaft and the solid cover from the left end.

2. Move the control lever to the left end, as shown in Figure 23, and secure with the notched cover and spring.

3. Install the solid cover on the right end of the shaft.

D. Pre-Set Selections

Some operations will require a limited range of transmission speed ratios and often they will alternate between forward and reverse speeds. Therefore, five tapped holes have been incorporated in both sides of the selector housing which accommodate two stop screws, as shown in Figure 23. The screws can be placed in one of three specific holes which will stop the selector lever at third, fifth, or seventh speed, and in one of two other holes, to stop the lever in either R_1 or R_2, as shown in Figure 23. A bypass plate, available as an accessory, is installed over the neutral notch to prevent the lever from stopping at the Neutral position. When the use of these stops is desired, they should be installed on the control lever side of the selector assembly. When they are not desired, they should be carried on the tractor by installing them on the side opposite the control lever. When shipped from the factory, the control lever is installed on the right side of the selector assembly and the stop screws are carried under the selector shaft left cover.

E. Selector Lever Alignment

For positive identification of speed selections, selector alignment is important. The individual speed identifications on the dial should always register with the pointers in the selector housing. The following adjustment makes it possible to compensate for normal wear in the selector assembly and for slight wear of the flexible selector cable.

1. Remove the selector shaft left cover to expose the shaft and hex nut as shown in Figure 24.

   NOTE: *If the selector lever is on the left side, remove it and mount it on the right side while making the adjustment.*

2. Move the selector lever to the neutral position and, with a suitable wrench, such as a deep well socket, loosen the nut while holding the lever securely in the detent, as shown in the Insert, Figure 24.

3. The dial can now be moved in either direction as required, to register the dial with the pointers without

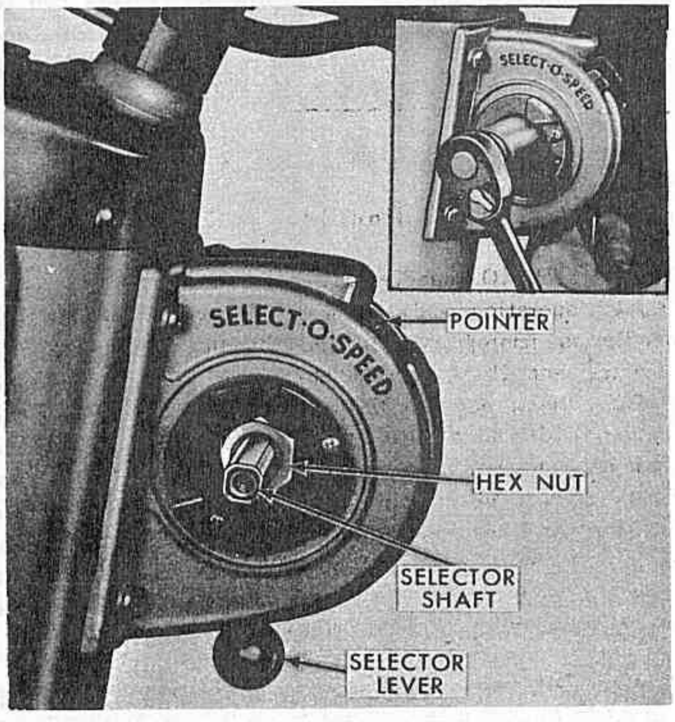


Figure 24
Alignment of the Selector Assembly

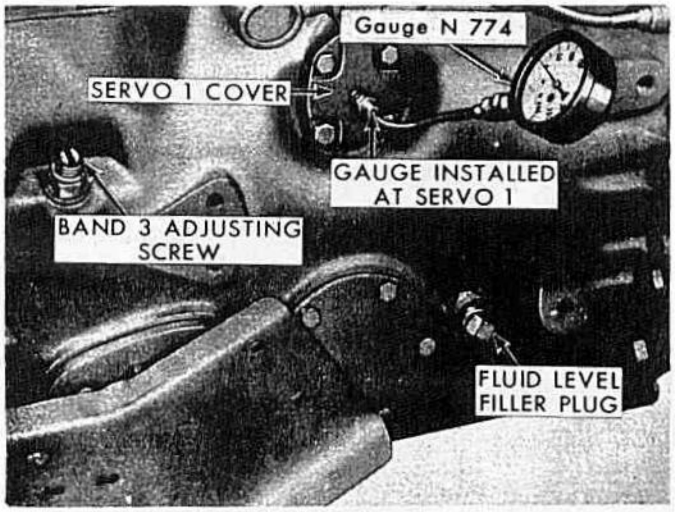


Figure 25
Guage Installed in Servo 1

changing the relationship of the flexible cable with the control valve assembly.

4. With the dial in the proper position, hold the lever and tighten the hex nut to 25–35 ft. lbs. torque.

5. Check for proper dial registration adjustment in all speed selections and replace the shaft cover.

   NOTE: *If the selector is difficult to operate, binding at the transmission cover may exist. This can be overcome by loosening the cover mounting bolts and tapping the cover to reposition it. Before tightening the cover bolts, check the P.T.O. handle for ease of operation.*

F. P.T.O. Control Handle Adjustment

Correct P.T.O. handle travel is essential for proper P.T.O. operation and transmission functioning. If the handle is improperly adjusted, handle travel will be affected and it is possible to continually feather the P.T.O. clutch pack in the handle engaged–disengaged positions. If the handle is properly adjusted, with the transmission functioning properly, the transmission lube light in the handle full in and out positions will remain "OFF." As long as the handle is in the intermediate or feathered position, the light will remain "ON." An improperly adjusted P.T.O. handle adjustment will also be reflected in low transmission pressure readings.

If improper P.T.O. control handle adjustment is indicated:

1. Pull the P.T.O. handle to its out position.

2. Disconnect the lower P.T.O. conduit fitting and loosen the upper fitting behind the tractor hood. See Figure 32.

3. Remove the upper jam nut and washer and push the control assembly through the opening.

4. Turn the P.T.O. handle clockwise until the lower end of the conduit can be raised above the fitting on the transmission cover. Pull the handle to make sure it is fully "out."

5. Turn the P.T.O. handle counterclockwise until the lower end of the conduit just contacts the fitting on the cover.

6. Connect the lower fitting, reinstall the assembly through the opening and secure with the jam nut. Tighten the upper conduit fitting.

7. Recheck lube light operation to determine if adjustment overcame the difficulty.

NOTE: *If the P.T.O. control handle is difficult to operate, binding may exist at the transmission cover. This can be overcome by loosening the cover mounting bolts and tapping the cover to reposition it. Before tightening the cover bolts, check the speed selector for ease of operation.*

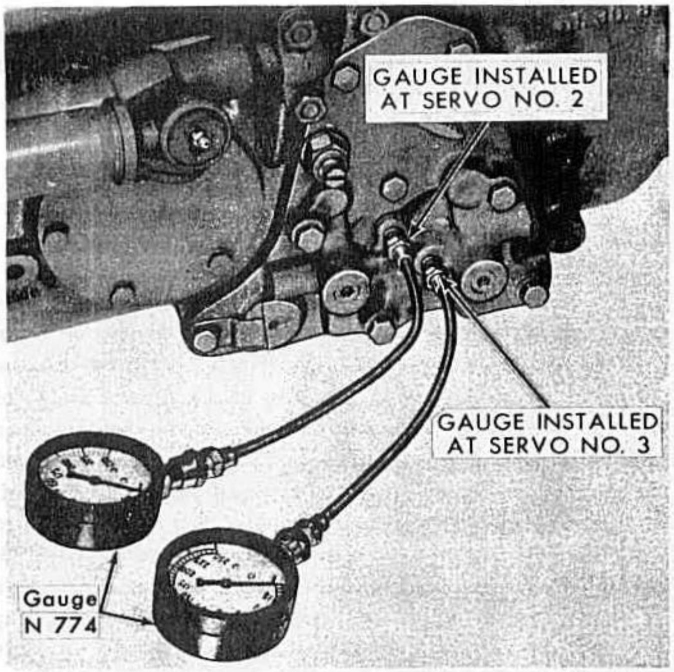

GAUGE INSTALLED AT SERVO NO. 2
GAUGE INSTALLED AT SERVO NO. 3
Gauge N 774

Figure 26
Guages Installed In Servos 2 and 3

G. Control Valve Adjustment

Valve adjustment is to be performed when:

The transmission pressures have been checked and it has been determined that valve adjustment is required.

The valve body has been reassembled after servicing, so that the correct pressure settings can be made.

The procedure for adjusting the valve and checking valve pressures in this section is also effective for trouble shooting purposes to determine:

The condition of the transmission hydraulic system.

If transmission malfunctioning is the result of incorrect pressure settings or other circuit difficulties.

ADJUSTING THE VALVE

1. Lock the traction coupling in the disengaged position.
2. Remove the hex head plugs from Servos 1, 2, and 3, and install the pressure gauges. See Figures 25 and 26.
3. Start the tractor engine and warm up the transmission fluid to 120° F. Operate the engine at 800 rpm when checking pressures.

NOTE: *It is essential that the engine is operating properly so that accurate pressure readings are obtained.*

4. Remove the transmission cover and control valve, as covered on page 35.
5. Remove the screws which secure the retainers to the upper valve body and remove the retainers.

   NOTE: *If the plungers have been removed, the plunger heads should be initially set flush with the valve body. If the valve body halves have been disassembled, the halves are to be aligned as covered on page 58.*
6. Remount the valve assembly on the distributor and secure the filter to the valve.
7. With the valve in park (P) position, start the engine by grounding the safety starter switch wire. Operate the engine at 800 rpm.
8. Referring to Figure 27, locate the valve plunger to be adjusted. Use an offset screwdriver or the retainer removed in step 5, as shown in Figure 28, to turn the adjusting screws. The procedure is detailed under "Checking Valve Pressures." The following chart summarizes this procedure for ready reference.
9. When the control valve has been properly adjusted, remove the filter and control valve and install the retainers removed in step 5. If necessary, turn the adjusting screws inward so that the slots in the screws will align with the retainers.
10. Install the valve body, filter, and transmission cover as outlined on pages 35 and 36.

CHECKING VALVE PRESSURES

The procedure for checking valve pressures requires following steps 1 through 3 on page 22 "Adjusting the

	Gear Ratios	*Inching Pedal*	*P.T.O. Handle*	*Lube Light*	*PRESSURE READINGS*		
					Servo 1	*Servo 2*	*Servo 3*
System Relief Valve	All*	Up or Down	In or Out	Off	*180 ± 10	*180 ± 10	*180 ± 10
Transmission Reg. Valve	Neutral	Midway	In	On		150 ± 5	
P.T.O. Regulating Valve	Neutral	Up	Midway	On		150 ± 5	
Lube Relief Valve	All	Up	Out	Off		**	

* 180 ± 10 psi should exist at each servo location when pressurized in accordance with the chart on page 23, as the transmission selector is shifted through all the gear ratios. A difference of more than 3 psi should not exist between servo locations.

** Proper lube pressure exists if the lube sender light remains off when system relief pressure is recorded at 180 psi. If pressure is recorded in the rear support opening, a pressure reading from 2 – 12 psi should exist.

NOTE: *When adjusting the regulating valves, the neutral position is obtained by rotating the valve camshaft three positions from park (P) in the direction shown in Figure 28.*

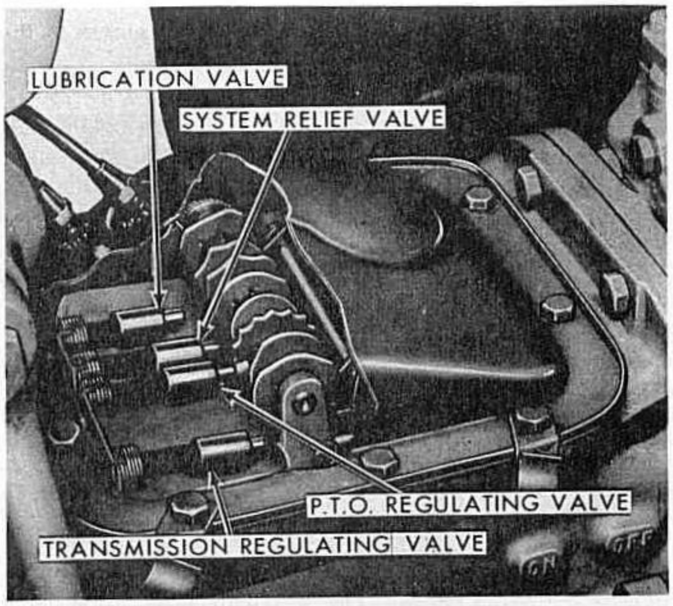


Figure 27
Control Valve Assembly

Control Valve" and following the specific instructions under each heading below.

It should be noted that the chart on page 22 summarizes this checking procedure and therefore may be referred to, after the procedure is understood.

System Relief Valve Pressure: Shift the selector lever through each gear ratio (P.T.O. handle in) noting the pressure readings at the three servo locations. If the respective servos are pressurized at 180 ± 10 psi in accordance with the following chart, the system relief valve is functioning properly. If the pressures are consistently out of specification, adjust the valve.

PRESSURE GAUGE READINGS

Gear Ratio	*Band 1 Servo*	*Band 2 Servo*	*Band 3 Servo*
P			
R_2	180	180	
R_1		180	
N		180	
1st		180	
2nd		180	
3rd	180	180	
4th	180	180	
5th			180
6th			180
7th	180		180
8th	180		180
9th		180	180
10th	180	180	180

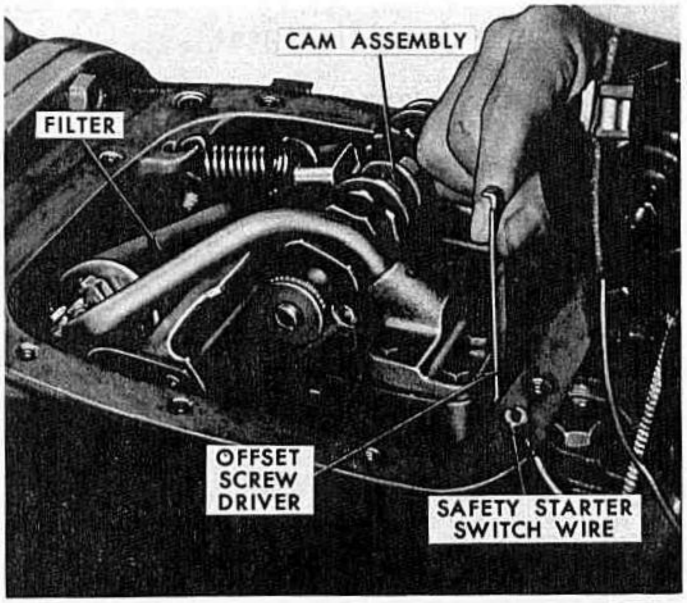


Figure 28
Adjusting Valve Pressures

NOTE: *If the pressure checks are used to diagnose transmission malfunctioning, proceed as follows:*

1. Record the pressure readings and compare them with the five Hydraulic Conditions covered on pages 26 and 27.
2. If a pressure differential of more than 3 psi is noted between servo readings, refer to Hydraulic Condition 5.
3. Pull the P.T.O. handle out. If the pressure drops, a leak is occurring in the P.T.O. clutch circuit.

Transmission Regulating Valve Pressure: Shift the selector lever to neutral and hold the inching pedal in the mid-position so that the lube light flashes on. This indicates the transmission feathering valve is bleeding oil to sump and that system pressure is not being maintained. The transmission regulating valve is acting as a check valve and if properly adjusted will maintain 150 ± 5 psi in the transmission direct circuit. The pressure setting will be reflected at servo 2 gauge. If the pressure reading is not to specification, adjust the valve.

NOTE: *The P.T.O. handle must be fully in and the inching pedal should be positioned so as to obtain the lowest possible gauge reading.*

P.T.O. Regulating Valve Pressure: Shift the selector lever to neutral and pull the P.T.O. handle to its mid-position so that the lube light flashes on. This indicates the P.T.O. feathering valve is bleeding oil to sump and

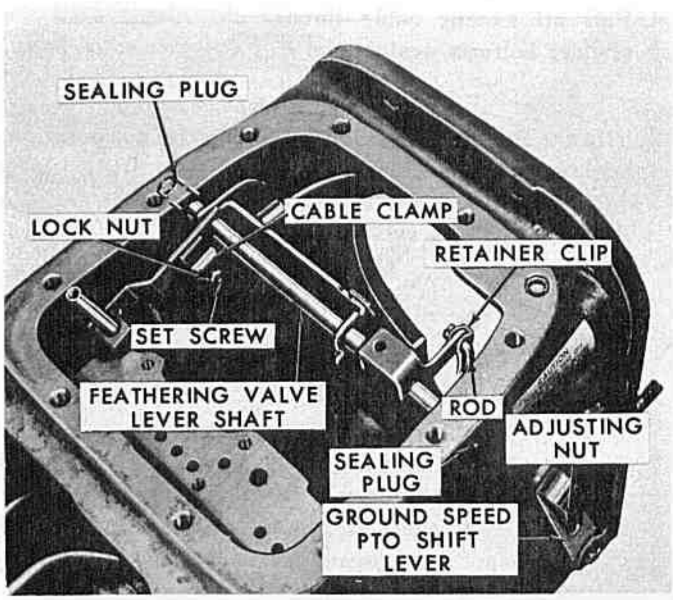


Figure 29
Feathering Linkage

that system pressure is not being maintained. The P.T.O. regulating valve is acting as a check valve and if properly adjusted will maintain 150 ± 5 psi in the transmission direct circuit. The pressure setting will be reflected at servo 2 gauge. If the pressure setting is not to specification, adjust the valve.

Lubrication Relief Valve Pressure: If during the preceding checks the transmission lube light flashed on when the system pressure dropped below 180 ± 10 psi, the lubrication relief valve is functioning properly. If, however, the lube light remains lit when the pressure is 180 ± 10 psi, adjust the valve.

NOTE: *If the lubrication relief valve is adjusted to maximum pressure and the lube light continues to remain on, refer to Hydraulic Condition 1 for low lube pressure causes.*

If malfunctioning in the lube circuit or sender switch is thought to exist, the lubrication pressure should be checked as follows:

1. Remove the left-hand step plate and the traction coupling shifter plate.
2. Remove the lube light wire from the sender switch terminal.
3. Unscrew the sender switch from the transmission rear support. Install a suitable fitting into the 1/8" pipe thread tapped opening and adapt a 15–30 psi pressure gauge.
4. Operate the tractor at 800 engine rpm and shift the selector lever through all gear ratios. The lubrication pressure should be 2–12 psi. If the pressure is not to specification, replace the sender switch or refer to Hydraulic Condition 1, page 26, as required.

H. Ground Speed P.T.O. Interlock Adjustment

To prevent engaging both the ground speed P.T.O. and the engine P.T.O. at the same time, an interlock is provided, Figures 29 and 30. The interlock consists of a flexible cable, enclosed in a conduit. The cable connects the P.T.O. feathering valve lever and a plunger and bracket arrangement at the ground speed P.T.O. lever.

With the P.T.O. clutch pack disengaged, the cable is completely extended through to the P.T.O. lever so that the plunger is below the forked bracket. When the ground speed lever is moved forward to engage ground speed P.T.O., the plunger moves to surround the cable. In this position, the plunger cannot be raised by the cable to engage the engine P.T.O. clutch pack.

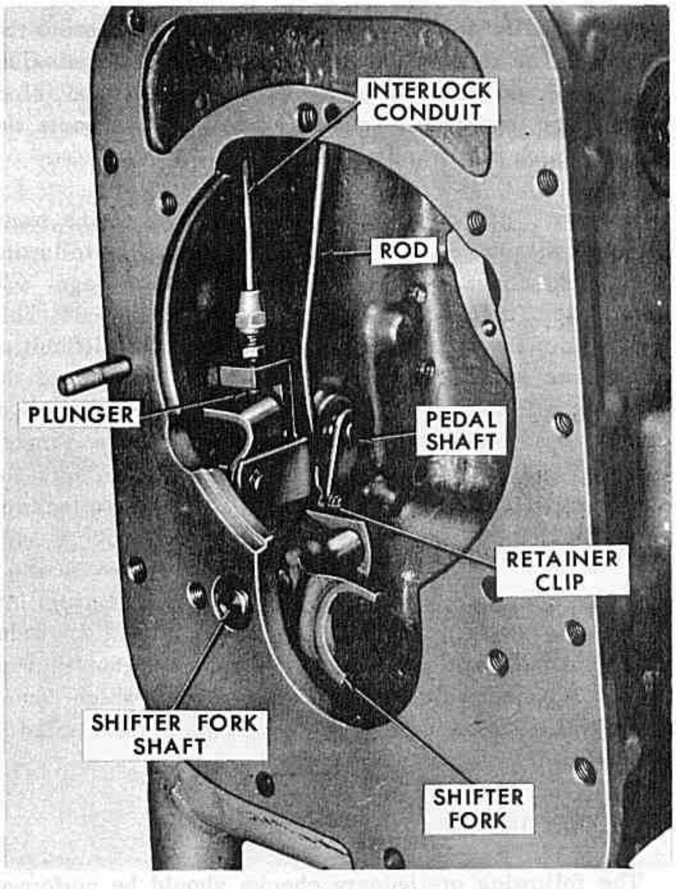


Figure 30
P.T.O. Interlock Linkage

When the P.T.O. clutch is engaged, the cable is pulled up so that the feathering valve lever depresses the valve spool into the valve body. In this position, the plunger lies in the path of the forked bracket so that the ground speed P.T.O. cannot be engaged.

Adjust the interlock mechanism as follows:

1. Remove the transmission cover as covered on page 35.
2. Position the ground speed shift lever in the forward notch to engage the ground speed P.T.O. If sufficient lever travel is not available, loosen the adjusting nut on the lever and reposition the lever plate. See Figure 29.
3. Loosen the lock nut and set screw in the cable clamp, shown in Figure 29.
4. Pull all excess cable through the clamp until the plunger bottoms against the P.T.O. shift shaft lever.
5. With the P.T.O. feathering plunger in the out position, secure the cable clamp so that .005" – .015" clearance exists between the end of the plunger and the P.T.O. feathering valve lever.
6. Engage the ground speed P.T.O. lever and pull up on the cable connector. The feathering valve lever should not move the feathering valve spool.
7. Disengage the ground speed P.T.O. and pull up on the P.T.O. control cable connector to depress the feathering valve. Now check to be certain the ground speed P.T.O. cannot be engaged.

9. TROUBLE SHOOTING

A systematic procedure must be followed to locate the causes of an inoperative or malfunctioning transmission. The procedure consists of a series of mechanical, electrical, and operational checks, designed to locate the specific area of difficulty.

However, depending upon the condition of the transmission, the problem may be easily diagnosed by following the checks covered in the Preliminary Checks, page 25, or by using Table I of the Diagnosis Guide, page 31. This guide lists the causes of various operational difficulties which are expressed in problem form. Table II of the Diagnosis Guide, page 32, lists the possible causes of the general conditions given in Table I. The Trouble Shooting Chart, page 30, expresses in tabular form the information included in Table I. A complete explanation of the chart is given on page 27.

If the transmission problem is one of overheating, low circuit pressures, or slippage in certain gear ratios, under loaded conditions, the more thorough Diagnostic Procedure should be followed. A transmission which cannot be operated will of necessity have to be disassembled to determine the cause of difficulty.

A. Preliminary Checks

The following preliminary checks should be performed before any thorough diagnosis is made. These checks are based on the operation of the transmission and the use of the lube light. If the lube light electrical circuit is known to be defective, the items marked with an asterisk (*), should be performed.

If the lube light remains ON check for:

* 1. Low fluid level. Refer to page 18.

* 2. Improper P.T.O. handle adjustment. Refer to page 21.

3. Shorted lube circuit electrical connections or defective sender switch.

* 4. Low circuit pressures. Refer to Diagnostic Procedure.

If the lube light remains OFF check for:

1. Broken electrical connection or defective fuse (only prior to engine starting up).

* 2. Improper band adjustment. Refer to page 19.

* 3. Disengaged traction coupling. Refer to page 19.

* 4. Excessive circuit pressures. Refer to Diagnostic Procedure.

NOTE: *It is possible for the transmission to lock up in certain gear ratios under some malfunctioning conditions. Therefore, when making pressure or operational checks, the engine speed should not exceed 800 rpm. If a lock-up is detected, quickly depress the inching pedal or if necessary, move the selector lever to another gear ratio to prevent the engine from stalling.*

Torque Limiting Clutch Check: The torque limiting clutch mounted on the engine flywheel, is designed to slip under torques encountered from impact or shock loadings. If for any reason, it is suspected that the torque clutch is not transmitting engine torque, a clutch slippage check can be made. Refer first to the Diagnostic Procedure Hydraulic Condition 4.

1. Operate the tractor under load until the engine and transmission have reached the operating temperature at which the condition occurred.
2. Under a fully loaded condition, operate the tractor in 8th, 9th, or 10th gear at full throttle and quickly apply both brakes to simulate a shock loading and to slip the torque limiting clutch.

IMPORTANT: ***Never use the above procedure below 8th gear.***

a. If the engine pulls down to 1000 rpm and the engine stalls, the clutch is holding.

b. If the brakes completely restrain the forward motion of the tractor and the engine does not lug down below 1000 rpm, torque limiting clutch slippage is indicated.

If the above preliminary checks were not effective in determining the cause of the difficulty, it will be necessary to check system pressures, as covered in the Diagnostic Procedure.

B. Diagnostic Procedure

This procedure is to be used in conjunction with the procedure for adjusting or checking valve pressures, covered on page 22. It uses the operation of the lube light with the pressure readings to segregate hydraulic difficulties into five hydraulic conditions. The first four hydraulic conditions do not outline a procedure as such, but instead provide possible causes which result in the given condition. Consequently, when observing consistently high or low pressure readings or a malfunctioning lube light, record the information and compare it with the corresponding hydraulic condition.

In the case of Hydraulic Condition 5, a step-by-step procedure is provided which must be performed in conjunction with the pressure checking procedure.

Hydraulic Condition 1: Pressures to specification and lube light remains ON.

1. Improperly adjusted or stuck lube relief valve.
2. Excessive transmission end clearances.
3. Restriction in lube circuit.
4. Broken lube circuit shaft seals.
5. Defective lube sender switch.

NOTE: *If all pressures are to specification and rough shifting characteristics exist, check valve body alignment, direct drive clutch valve operation, and band adjustment.*

Hydraulic Condition 2: Pressures above specification and lube light remains OFF.

1. Improperly adjusted or stuck lube relief valve.

Hydraulic Condition 3: Pressures below specification and lube light remains OFF.

1. Improperly adjusted or stuck lube relief valve.
2. Other system problems in conjunction with defective lube sender circuit.

Hydraulic Condition 4: Pressures below specification and lube light remains ON.

1. Low fluid level.
2. Plugged or improperly installed suction screen or restricted suction port.
3. Defective pump adapter plate or gaskets.
4. Defective main pressure tube or "O" rings.
5. Restricted main pressure circuit.
6. Defective direct drive clutch inlet tubes or "O" rings.
7. Leaking or missing direct drive clutch valve body gasket.

8. Missing direct drive clutch valve spool.

9. Leaking or missing valve body gasket.

10. Leakage between valve body halves.

11. Improperly adjusted valve body.

12. Missing valve body spools B1, B2, or B3.

13. Improperly assembled feathering valve.

14. Defective torque limiting clutch.

15. Improperly adjusted P.T.O. handle.

NOTE: *If the pressures are* **to specification** *when inching pedal is fully depressed, leakage is indicated in the transmission indirect circuit in the valve body. Refer to Hydraulic Condition 5. If the pressures are* **below specification** *only when the P.T.O. handle is out, and the handle is known to be properly adjusted, leakage is indicated in the P.T.O. clutch circuit.*

Hydraulic Condition 5: Pressure below specification in certain gear ratios and lube light ON.

1. Observe in which gear ratios low pressure readings occur.

2. Fully depress inching pedal in gear ratios where low pressure readings occur and note lube light and pressure readings at servos 1, 2, and 3.

   a. If pressure increases and lube light goes off, leakage is occurring in the transmission indirect circuit consisting of C1, C2, and C3.

   b. If pressures at B1, B2, and B3 servos remain low, leakage is occurring in the direct circuit consisting of servo 1, servo 2, servo 3, and the direct drive clutch.

3. Use the Trouble Shooting Chart on page 30 and note which servos and clutch packs are pressurized where low pressure readings occur. A process of elimination will pinpoint which servo or clutch is leaking.

C. Trouble Shooting Chart

The trouble shooting chart shows the application of the various clutch packs and bands for each gear ratio. The applied band or clutch is indicated by the bold red letter "A." Should a band or clutch for some reason be inoperative, either constantly applied or released, transmission malfunctioning will result. Either of these conditions can be determined by using columns "a" or "r," under the band or clutch involved. The column under "a" indicates the clutch pack or band is constantly applied while "r" indicates a constantly released condition.

Thus, if the tractor is operative in some gears, inoperative in others, and locks up, i.e. stalls or lugs down the engine in the remaining gears, the vertical columns under "a" and "r" should be checked to determine which column corresponds with the condition encountered. The check is performed by operating the tractor at 800 engine rpm and noting the transmission operation in each gear ratio. For example, if the tractor goes to Neutral in R_1, R_2, 9th, and 10th, and operates properly in the remaining gear ratios, a quick check of the vertical columns will show that Clutch 1 remains released and will not apply.

Position or Gear Ratio	C_1	
	a	r
Park (P)	L	P
R_2	R_2 **A**	N
R_1	R_1 **A**	N
Neutral (N)	R_1	N
1st	L	1
2nd	L	2
3rd	L	3
4th	L	4
5th	L	5
6th	L	6
7th	L	7
8th	L	8
9th	9 **A**	N
10th	10 **A**	N

A Applied for that position

a, Applied and does not release

r, Released and does not apply

L, Indicates lock-up

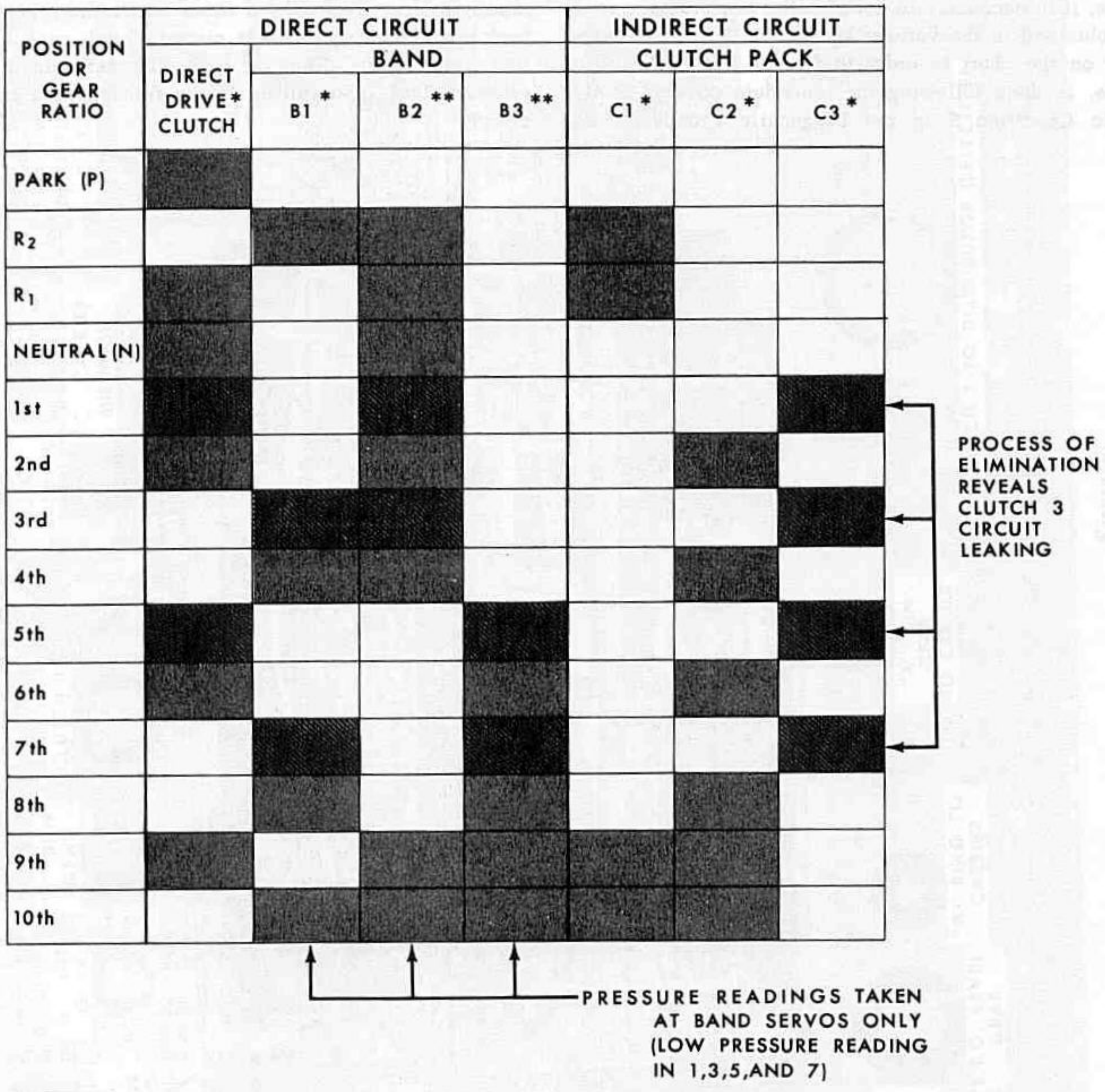
NOTE: *In the case of B1, column "a," a dual condition is possible in some gear ratios, depending whether the band remains mechanically or hydraulically applied. See Table I.*

When the trouble shooting chart is used in conjunction with the pressure checks, the band or clutch columns must be approached solely from a hydraulic pressure application standpoint whether the element itself is applied or released. The pressure applications on the chart are indicated by the red shaded areas. Thus, for 3rd gear ratio, hydraulic pressure is applied to band 1 servo, band 2 servo, and clutch pack 3. The asterisks (*) indicate whether the clutch or band is pressure or spring applied.

Since the pressure checks are made only at the band servos, it is necessary to compare the low pressure readings obtained in the various gear ratios with the shaded areas on the chart in order to form a pattern. This, of course, is done following the procedure covered in Hydraulic Condition 5 in the Diagnostic Procedure. For example, low pressure readings are noted in 1st, 3rd, 5th, and 7th.

The feathering pedal is depressed in each of these ratios as covered in 2a of Hydraulic Condition 5. The warning light goes out and pressures at band servos 2 and 3 increase to specification. The leak is in the indirect circuit. Since only gear ratios 1, 3, 5, and 7 are affected, and since only the indirect circuit is involved, it is readily indicated by shaded areas on the chart that clutch pack 3 is the only indirect circuit clutch pack used in these gear ratios. Thus, it is readily determined that a pressure leak is occurring in the transmission clutch 3 circuit.

TROUBLE SHOOTING LOW CIRCUIT PRESSURES



POSITION OR GEAR RATIO	DIRECT CIRCUIT	DIRECT CIRCUIT	DIRECT CIRCUIT	DIRECT CIRCUIT	INDIRECT CIRCUIT	INDIRECT CIRCUIT	INDIRECT CIRCUIT
		BAND			CLUTCH PACK		
	DIRECT DRIVE* CLUTCH	B1 *	B2 **	B3 **	C1 *	C2 *	C3 *
PARK (P)	▨						
R_2		▨	▨		▨		
R_1	▨		▨		▨		
NEUTRAL (N)	▨		▨				
1st	■		■				■
2nd	▨		▨			▨	
3rd		■	■				■
4th		▨	▨			▨	
5th	■			■			■
6th	▨			▨		▨	
7th		■		■			■
8th		▨		▨		▨	
9th	▨		▨	▨	▨	▨	
10th		▨	▨	▨	▨	▨	

PROCESS OF ELIMINATION REVEALS CLUTCH 3 CIRCUIT LEAKING

PRESSURE READINGS TAKEN AT BAND SERVOS ONLY (LOW PRESSURE READING IN 1,3,5,AND 7)

▨ HYDRAULIC PRESSURE ON

■ LOW PRESSURE INDICATED

* PRESSURE APPLIED

** SPRING APPLIED

SELECT-O-SPEED TROUBLE SHOOTING CHART

POSITION OR GEAR	DIRECT CIRCUIT												INDIRECT CIRCUIT								
	DIRECT DRIVE CLUTCH *			BAND									CLUTCH PACK								
				B1 *			B2 **			B3 **			C1 *			C2 *			C3 *		
	a		r	a		r	a		r	a		r	a		r	a		r	a		r
Park (P)	P	A ▨	P	L-P		P	P	A	N	P	A	N	L		P	L		P	L		P
R_2	L		R_2	R_2	A ▨	N	L	▨	R_2	R_2	A	N	R_2	A ▨	N	L		R_2	L		R_2
R_1	R_1	A ▨	N	L-R_2		R_1	L	▨	R_1	R_1	A	N	R_1	A ▨	N	L		R_1	L		R_1
Neutral (N)	N	A ▨	N	L-N		N	P	▨	N	N	A	N	R_1		N	2		N	1		N
1st	1	A ▨	N	L-3		1	L	▨	1	1	A	N	L		1	L		1	1	A ▨	N
2nd	2	A ▨	N	L-4		2	L	▨	2	2	A	N	L		2	2	A ▨	N	L		2
3rd	L		3	3	A ▨	N	L	▨	3	3	A	N	L		3	L		3	3	A ▨	N
4th	L		4	4	A ▨	N	L	▨	4	4	A	N	L		4	4	A ▨	N	L		4
5th	5	A ▨	N	L-7		5	5	A	N	L	▨	5	L		5	L		5	5	A ▨	N
6th	6	A ▨	N	L-8		6	6	A	N	L	▨	6	L		6	6	A ▨	N	L		6
7th	L		7	7	A ▨	N	7	A	N	L	▨	7	L		7	L		7	7	A ▨	N
8th	L		8	8	A ▨	N	8	A	N	L	▨	8	L		8	8	A ▨	N	L		8
9th	9	A ▨	N	L-10		9	L	▨	9	L	▨	9	9	A ▨	N	9	A ▨	N	9		9
10th	L		10	10	A ▨	N	L	▨	10	L	▨	10	10	A ▨	N	10	A ▨	N	10		10

A, applied for that position
L, indicates lock-up

▨ **hydraulic pressure on.**

*** pressure applied**
**** spring applied**

Black columns "a" and "r" indicate inoperative condition for each band and clutch.
a, applied and does not release.
r, released and does not apply.

TABLE 1

DIAGNOSIS GUIDE

PROBLEM	CONDITION
1. Transmission remains in Park	1. a. Low fluid pressure b. Bands 2 and 3 remain applied c. Damaged or broken selector cable
2. Transmission goes to Neutral	2. a. Traction coupling disengaged b. Damaged or broken selector cable
3. Transmission functions in all selector positions but can be held in tenth speed without stalling the engine (1500 rpm) when brakes are applied	3. a. Low fluid pressure b. Defective torque limiting clutch
4. Transmission goes to Neutral in Park, N, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10	4. Mainshaft broken or damaged splines at "B" carrier, or C2 –C3 housing assembly
5. Transmission goes to Neutral in R_1, N, 1, 2, 5, 6, and 9	5. Direct drive clutch does not apply
6. Transmission goes to Neutral in R_2, N, 3, 4, 7, 8, and 10	6. Band 1 does not apply
7. Transmission goes to Neutral in Park, N, 5, 6, 7, and 8	7. Band 2 does not apply
8. Transmission goes to Neutral in Park, R_1, R_2, N, 1, 2, 3, and 4	8. Band 3 does not apply
9. Transmission goes to Neutral in R_1, R_2, N, 9, and 10	9. Clutch 1 does not apply
10. Transmission goes to Neutral in N, 2, 4, 6, 8, 9, and 10	10. Clutch 2 does not apply
11. Transmission goes to Neutral in N, 1, 3, 5, and 7	11. Clutch 3 does not apply
12. Transmission locks up in R_2, 3, 4, 7, 8, and 10	12. Direct drive clutch does not release
13. Transmission locks up in Park, R_1, N, 1, 2, 5, 6, and 9	13. Band 1 does not release (mechanical) *
14. Transmission functions in overdrive gear ratios when direct drive selections are made	14. Band 1 does not release (Band 1 spool valve stuck) *
15. Transmission locks up in R_2, R_1, 1, 2, 3, 4, 9, 10, and goes to Park in Neutral	15. Band 2 does not release
16. Transmission locks up in 5, 6, 7, 8, 9, and 10	16. Band 3 does not release
17. Transmission locks up in Park, 1, 2, 3, 4, 5, 6, 7, and 8, and goes to R_1 in Neutral	17. Clutch 1 does not release
18. Transmission locks up in Park, R_1, R_2, 1, 3, 5, 7, and goes to 2 in Neutral	18. Clutch 2 does not release
19. Transmission locks up in Park, R_1, R_2, 2, 4, 6, 8, and goes to 1 in Neutral	19. Clutch 3 does not release

* Reason for dual condition in B (a) Trouble Shooting Chart

TABLE II
DIAGNOSIS GUIDE

Condition	Possible Cause	
1. Low pump fluid pressure (all gear ratios)	1. Refer to Hydraulic Condition 4, page 26.	
2. Direct Drive Clutch Inoperative. (Does not apply)	2. a. Broken input shaft seals. b. Leaking front direct drive clutch pressure line or "O" rings. c. Leaking piston "O" rings.	d. Sticking direct drive clutch spool valve or broken return spring. e. Leaking sealing balls in input shaft or oil pump adapter plate. f. Sticking band 1 valve spool.
(Does not release)	a. Sticking direct drive clutch valve spool. b. Scored or burred piston.	c. Defective piston return spring. d. Warped or defective clutch discs.
3. Band 1 Inoperative (Does not apply)	3. a. Improper band adjustment. b. Missing band strut. c. Leakage between control valve body halves. d. Leaking valve body gasket.	e. Leaking servo 1 pressure line. f. Leaking servo "O" ring. g. Scoring or burring of servo. h. Leakage between direct drive clutch valve body and support or at the support thread.
(Does not release)	a. Improper band adjustment. b. Broken or defective servo return spring.	c. Sticking band valve spool. d. Scored or burred servo.
4. Band 2 or 3 Inoperative (Does not apply)	4. a. Improper band adjustment. b. Missing band strut. c. Broken or defective servo spring.	d. Scored or burred servo. e. Sticking band valve spool.
(Does not release)	a. Improper band adjustment. b. Leaking valve body gasket. c. Leakage between valve body halves.	d. Leaking fluid line "O" rings. e. Leaking servo "O" rings. f. Scored or burred servo.
5. Clutch 1 Inoperative (Does not apply)	5. a. Leaking valve body gasket. b. Leaking piston "O" rings. c. Broken Mainshaft seals.	d. Broken "C" sun gear seals. e. Broken distributor seals. f. Scored or burred piston.
(Does not release)	a. Sticking clutch valve spool. b. Scored or burred piston.	c. Broken or defective piston return spring. d. Warped or defective clutch discs.
6. Clutch 2 or 3 Inoperative (Does not apply)	6. a. Leaking valve body gasket. b. Leaking piston "O" rings. c. Broken mainshaft seals. d. Broken "C" sun gear seals.	e. Broken mainshaft or mainshaft splines. f. Leakage between valve body halves. g. Scored or burred piston.
(Does not release)	a. Sticking clutch valve spool. b. Scored or burred piston. c. Broken or defective piston return spring.	d. Warped or defective clutch plates. e. Severed No. 2 Servo interlock valve spool from Servo 3 piston.

10. SERVICING THE TRANSMISSION

The arrangement of the procedures in this section permits servicing the transmission with minimum disassembly. Transmission disassembly and assembly are separated into four groupings, as covered below. Each grouping includes those operations which can be performed or assemblies which can be serviced under the conditions established. In the case of Condition 4, it is necessary to follow the procedures in each of the preceding groupings to completely disassemble the transmission. In the case of 3, it is necessary to follow the procedures in Condition 1. A 5th grouping, covering detailed service procedures for the disassembly, repair, and assembly of sub-assemblies is also included.

Assemblies Serviced with Transmission Installed, page 34.

P.T.O. Cable Assembly
Speed Selector Assembly
Transmission Cover
Filter
Safety Starter Switch
Lubrication Oil Sender Switch
Servo Covers
Servo Assemblies

Assemblies Serviced with Tractor Split at the Rear of the Transmission, page 40.

Rear Support
Planetary Assemblies A, B, C, D
Clutch Packs Direct Drive, 1, 2, and 3
Oil Distributor
Brake Bands 1, 2, and 3
Feathering and Ground Speed P.T.O. Linkage
Servo Assemblies 1, 2, and 3

Assemblies Serviced with the Tractor Split Ahead of the Transmission, page 49.

Transmission Oil Pump
Pump Adapter Plate
Front P.T.O. Pressure Tube
Main Pressure and Front Direct Drive Clutch Tubes
Input Shaft Front Seals
Direct Drive Clutch Valve and Support Block
Servo 1 and Rear Direct Drive Clutch Tubes
P.T.O. Front Shaft
Torque Limiting Clutch

Assemblies Serviced with the Transmission Removed, page 52.

Input Shaft
P.T.O. Clutch Pack and Shaft
P.T.O. Pressure Tube
P.T.O. Shifter Linkage
Hydraulic Lift Transfer Tubes
All Other Transmission Components

Disassembly, Repair, and Assembly of Sub-Assemblies, page 55.

When disassembling the transmission, work in clean surroundings with clean tools. Thoroughly clean the transmission case to prevent dirt entry. Use only lint-free towels when wiping your hands or the parts. Lay cleaned parts out on new paper so that a thorough inspection can be made.

When assembling the transmission components, care must be exercised not to use force. If the parts do not assemble freely, examine them for the cause of difficulty. The following general instructions should be followed:

Always install new gaskets and seals.
Compare the shaft sealing rings with new ones or install new ones.

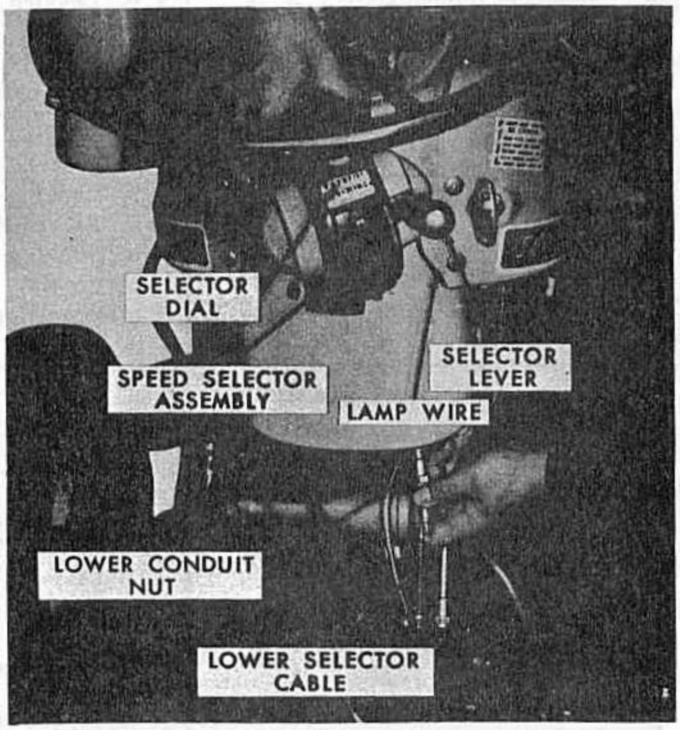


Figure 31
Removing Speed Selector

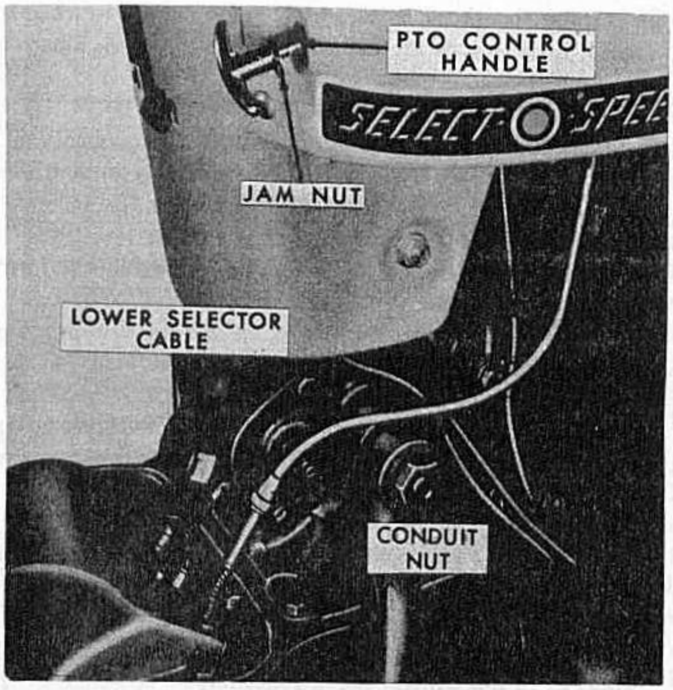


Figure 32
P.T.O. Control Removal

Use Lubriplate or Vaseline on the shaft sealing rings to center them on the shafts and on the gaskets and thrust washers so that they remain in position.

Care should be exercised when installing tubes with assembled "O" rings so that the sealing surfaces are not damaged. Always install the "O" rings in the chamfered end of the bore and use Vaseline or Lubriplate to facilitate assembly.

Refer to Figure 38 for the proper location of the thrust washers.

Always check P.T.O. shaft preload and front and rear compartment end play.

ASSEMBLIES SERVICED WITH TRANSMISSION INSTALLED

A. Speed Selector Assembly – Removal

1. Remove the four housing-to-sheet metal retaining screws.
2. Place the selector lever in park (P) and loosen the conduit nut at the transmission cover.
3. Move the selector lever to the tenth speed position, allowing the complete assembly to move away from the transmission cover, as shown in Figure 31.
4. Separate the upper cable from the lower cable, disconnect the selector lamp wire and remove the selector assembly by lifting it out of the tractor sheet metal.

B. P.T.O. Cable Assembly – Removed

1. Pull the control handle all the way out and completely loosen the conduit nut, Figure 32, at the transmission cover.
2. Loosen the nut securing the conduit to the control handle and the rod assembly at the back of the instrument panel.
3. Completely loosen the jam nut which secures the unit to the instrument panel.
4. Turn the P.T.O. cable clockwise until it disengages from the P.T.O. connector in the transmission.

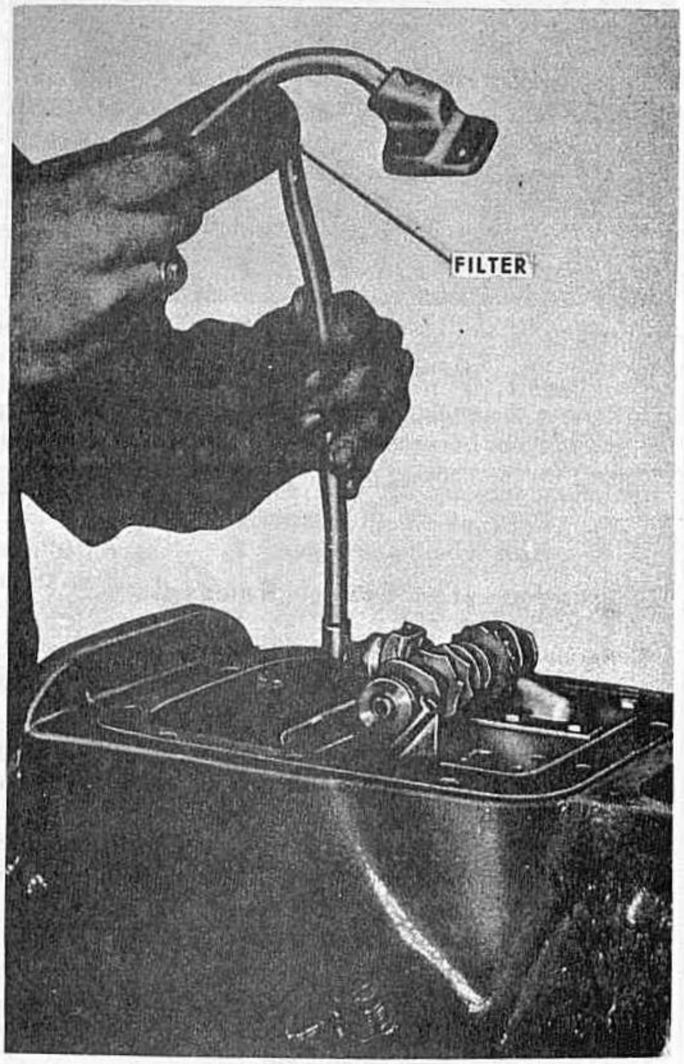


Figure 33
Filter Removal

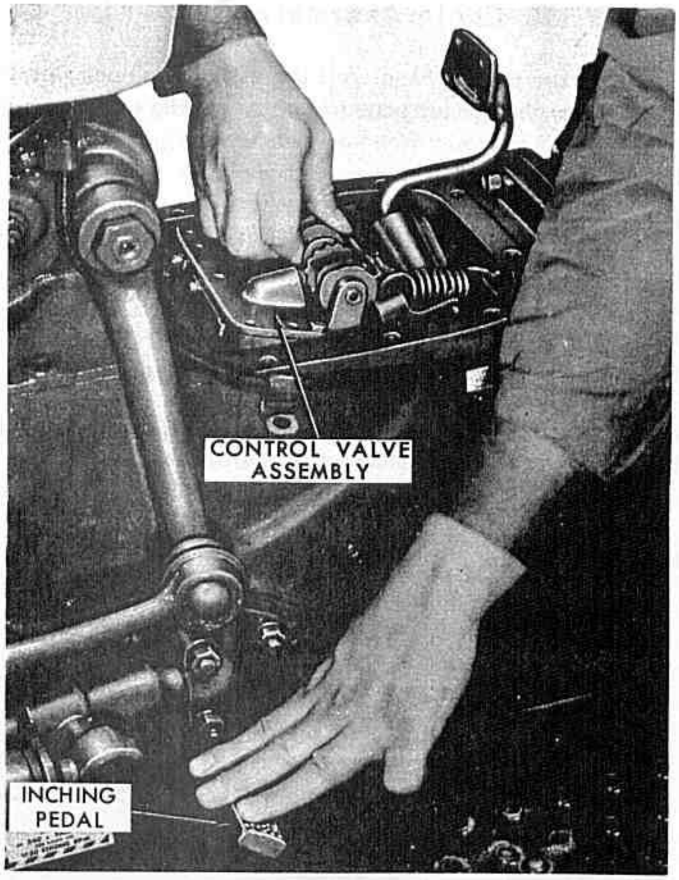


Figure 34
Removing Control Valve

5. Remove the cable assembly from the tractor by driving the roll pin from the handle and threading the conduit out from the bottom.

C. Transmission Cover – Removal

1. Remove the P.T.O. cable assembly and the speed selector assembly as covered under A. and B., above.
2. Remove the lower selector cable by turning it clockwise to thread it from the control valve assembly.
3. Remove the ten cover-securing bolts, and lift the cover sufficiently from the case to detach the safety starter switch wire. See Figure 14. Remove the cover.

D. Oil Filter, Safety Starter Switch, and Control Valve – Removal

1. Remove the P.T.O. cable speed selector and transmission cover as covered under A, B, and C, above.
2. Remove the three bolts which secure the filter manifold to the top of the control valve, Figure 14. Remove the pedal spring.
3. Lift out the manifold and filter as an assembly by lifting and threading the lower tube from around the "C" ring gear assembly. Refer to Figure 33.

   NOTE: *The filter or the pedal return spring need not be removed to remove the control valve. The upper manifold portion can be swung up and back to provide adequate clearance.*

4. Remove the two bolts that secure the safety starter switch bracket to the control valve, and remove the switch and bracket.
5. Remove the two mounting bolts at the left front of the control valve.

   NOTE: *Do not loosen the two bolts that hold the two halves of the control valve together.*

6. Depress the inching pedal and remove the control valve as shown in Figure 34.

   NOTE: *It may be necessary to gently pry the valve body to free the gasket sealing surface.*

E. Oil Filter, Safety Starter Switch and Control Valve – Installation

1. Assemble the filter inlet tube and flange to the inlet end of the filter can marked "IN" with the clamp, as shown in Figure 35. Make certain that the nuts of the retaining clamp are facing up and are loose enough to rotate the tube on the can.
2. Secure the outlet tube to the filter can, making sure that the clamp attaching nuts will be toward the rear of the transmission when the filter is installed. Tighten the two nuts securely.
3. Lower the outlet tube through the opening at the left rear of the transmission adjacent to the "C" ring gear. The tube is positioned between the interlock conduit and the inching pedal actuating rod.
4. Locate the web in the bottom of the transmission case by moving the lower end of the outlet tube forward and back. After locating the web, seat the clip at the lower end of the tube, as near as possible to the center of the transmission and still have clearance between the outlet tube and "C" ring gear.

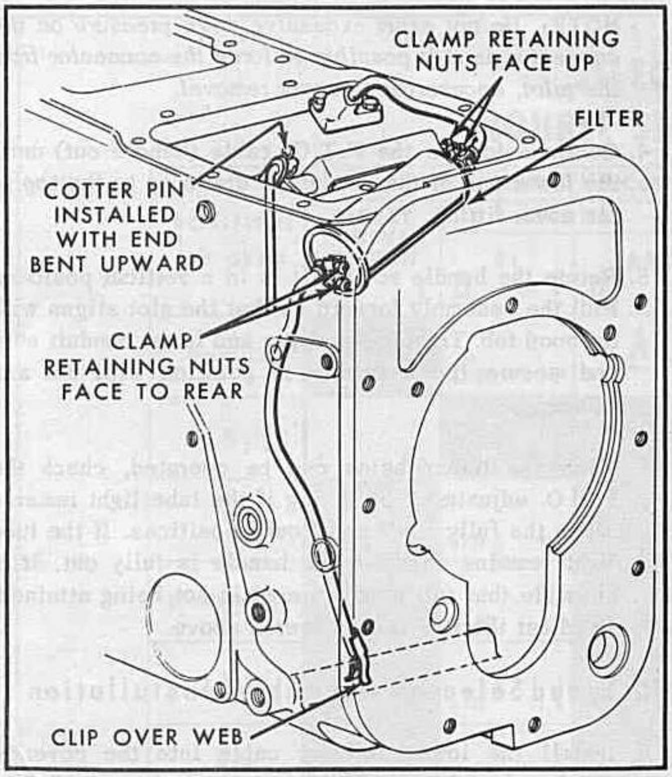

CLAMP RETAINING NUTS FACE UP
FILTER
COTTER PIN INSTALLED WITH END BENT UPWARD
CLAMP RETAINING NUTS FACE TO REAR
CLIP OVER WEB

Figure 35
Oil Filter Installation

5. Depress the inching pedal and install the control valve and gasket on the distributor.

NOTE: *If the control valve pressures are to be adjusted, the valve is to be installed with the plunger adjusting screw retainers left off. The pressure adjusting procedure is covered on page 22.*

6. Position a new filter inlet tube gasket on the control valve upper body. Align the holes in the inlet tube flange with those in the control valve. Install the two longer 1/4" bolts in the right side of the flange and the shorter 1/4" bolt in the remaining hole. Hold the filter in a position to provide clearance between the feathering pedal rod and outlet tube before tightening the three flange attaching bolts.

NOTE: *If interference between the outlet tube and feathering pedal rod is noted after tightening the bolts, move the retaining clip at the lower end of the outlet tube, toward the center of the transmission. Move the tube with a long screwdriver, just far enough to eliminate the interference.*

7. Tighten the inlet tube clamp nuts.

8. Install the safety starter switch with the camshaft in the park (P) position. The switch is to be held against the boss on the cam to assure switch actuation. Install the remaining two bolts and tighten all bolts to 6 to 8 ft. lbs. torque.

9. Install the inching pedal return spring.

NOTE: *If the control valve pressures are to be adjusted, the safety starter switch need not be installed. Instead, install and tighten the switch mounting bolts in the valve body. After the pressures have been adjusted, remove the filter inlet tube flange and the control valve. Install the adjusting screw retainers and reinstall the valve body and filter.*

F. Transmission Cover – Installation

1. Check the control valve to make sure it is in park (P). In park, all of the six spool valves are in the "out" position.

2. Thread the lower selector cable into the P.T.O. cable connector.

3. Lower the cover over the case and thread the cover wire under the valve camshaft and attach it to the safety starter switch.

4. Insert the cable through the P.T.O. connector pilot to thread the connector in the pilot. See Figure 36.

5. Align the cover bolt holes with the case and install and loosely tighten the bolts and lock washers.

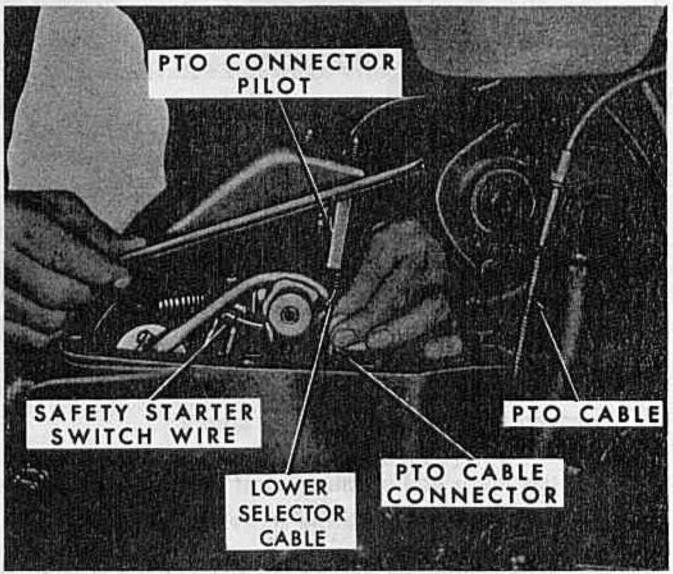


Figure 36
Transmission Cover Installation

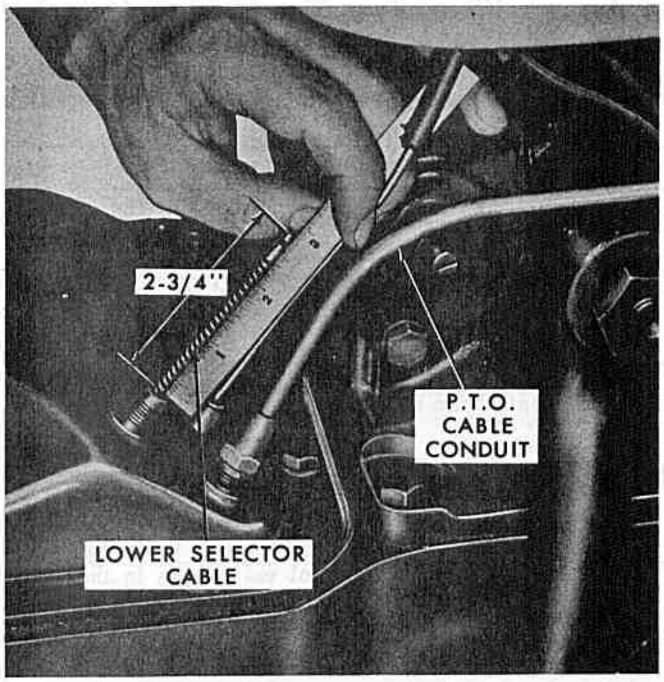


Figure 37
Installing Lower Selector Cable

6. Slide the cable up and down to be sure the cable connector is free to move and then remove the cable.

7. Install the cable through the cover in the cable wheel and note if the cable is easy to turn.

NOTE: *If binding in either steps 6 or 7 is encountered, it will be necessary to reposition the cover with respect to the case by tapping the cover as required.*

8. Tighten the cover bolts to 18 to 23 ft. lbs. torque.

G. P.T.O. Control Assembly—Installation

1. Install the P.T.O. control assembly in the tractor sheet metal. Install the handle with the roll pin and pull the handle to the "out" position. The upper inner conduit nut is to be loosened slightly. Refer to Figure 32.

NOTE: *If the P.T.O. control assembly has not been removed for servicing, refer to step 2.*

2. Lift the lower end of the conduit and insert the end of the cable in the cover fitting.

3. Permit the cable to go into the fitting until it contacts the P.T.O. cable connector and turn the P.T.O. handle counterclockwise to thread the cable into the connector.

NOTE: *Do not exert excessive down pressure on the connector as it is possible to force the connector from the pilot, necessitating cover removal.*

4. Continue to turn the P.T.O. cable (handle out) until the lower end of the conduit is drawn up to the top of the cover fitting.

5. Rotate the handle so that it is in a vertical position. Pull the assembly forward so that the slot aligns with the hood tab. Tighten the upper and lower conduit nuts and secure the assembly in position with nut and washer.

6. When the transmission can be operated, check the P.T.O. adjustment by noting if the lube light remains off in the fully "in" and "out" positions. If the lube light remains on when the handle is fully out, it is possible that full handle travel is not being attained. Readjust the P.T.O. as covered above.

H. Speed Selector Assembly—Installation

1. Install the lower selector cable into the cover to obtain a length of 2-3/4" as shown in Figure 37. The distance is determined from the top of the fitting to the upper side of the notch. This dimension synchronizes the selector to the control valve when the valve is in the park (P) position.

2. Insert the end of the selector conduit through the opening in the sheet metal and install the bullet connectors for the dial lamp.

3. Shift the selector to tenth speed so that the cable extends through the conduit.

4. Connect the selector cable to the lower cable extending from the cover and shift the selector lever to park (P) to bring the conduit to the fitting on the cover.

5. Tighten the lower conduit nut and secure the speed selector assembly to the hood with the four screws.

6. Shift the selector to Neutral and note if the dial is aligned with the housing. If misalignment is evident, align the selector as covered on page 20.

7. When the transmission can be operated, check the operation of the selector assembly in all gear ratios.

I. Servo 1 Strut—Replacement

1. Drain the transmission fluid.

2. Remove servo 1 cover and the servo. See Figure 55.

3. Remove the right transmission inspection cover and locate the strut in the bottom of the case.

4. Loosen band 1 adjusting screw lock nut and fully thread the screw into the case.

5. Use a sufficient quantity of heavy grease on the strut and insert the grease and strut through the servo opening so the strut is horizontally positioned to contact the slot in the servo.

6. Insert the servo in the opening. While holding it firmly in place, back off the adjusting screw as required, and install servo 1 cover. Adjust the band.

7. Install the inspection cover and fluid, operate the tractor, and adjust the band. See page 19.

J. Servo 1 Assembly or Piston "O" Ring – Replacement

1. Tighten the band 1 adjusting screw and loosen the four servo 1 cover attaching bolts until the servo piston "O" ring is just out of the servo bore. At the same time, thread the adjusting screw in to prevent the strut from dropping out of place.

2. Remove the four attaching bolts and remove the cover, being careful to apply pressure on the servo piston to prevent the strut from dropping out. Replace the piston "O" ring.

3. Still applying pressure on the piston, install servo 1 cover and four attaching bolts. When tightening cover bolts, simultaneously loosen the adjusting screw to allow servo piston to move into place.

4. Adjust the band and check transmission pressures. See pages 19 and 22.

K. Servo 2 Assembly or "O" Ring – Replacement

1. Drain the transmission fluid.

2. Remove the left-hand step plate and the inching pedal.

3. Loosen band 2 and 3 adjusting screws to relieve the tension from the servos, and remove servo 2 and 3 cover assembly. See Figure 49.

4. Remove the servo 2 and 3 lever and pin retainer from the right side of the transmission case. See Figure 48. Remove the transmission right inspection cover.

5. Tighten band 2 adjusting screw to remove the free travel in the band linkage.

6. Mark the end of servo 2 and the transmission case and rotate the servo 180° to free the servo piston rod from the lever and pin assembly. See Figure 49.

NOTE: *Freedom of the rod from the lever can be determined by inserting a hand in the inspection opening and noting when the lever is out of the slot.*

7. Remove the servo from the case, being careful that the lever does not move with the servo rod. If this occurs, the band strut can drop out of place, necessitating transmission disassembly.

8. Remove the piston rod guide out of the servo 2 bore.

9. Install the "O" rings and assemble the rod guide over the servo rod.

10. Install the servo with the slot positioned to the rear or 180° out of phase, being careful not to move the lever assembly.

11. Rotate the servo 180° so that the lever is positioned in the rod slot.

12. Reassemble the removed components, install the fluid, adjust the bands, and pressure-check the transmission. Refer to pages 19 and 22.

L. Servo 3 Assembly or "O" Ring – Replacement

1. Follow steps 1 through 4 under Servo 2 "O" Ring – Replacement.

2. Pull servo 3 far enough out of the case to replace the "O" ring. See Figure 49.

NOTE: *Servo 3 can be removed by rotating the assembly as covered under servo 2 removal above.*

3. Install the servo by using the interlock valve as a handle to lift the opposite end of the servo in position.

4. Reinstall the removed components, install the fluid, adjust the bands and pressure-check the transmission. Refer to pages 19 and 22.

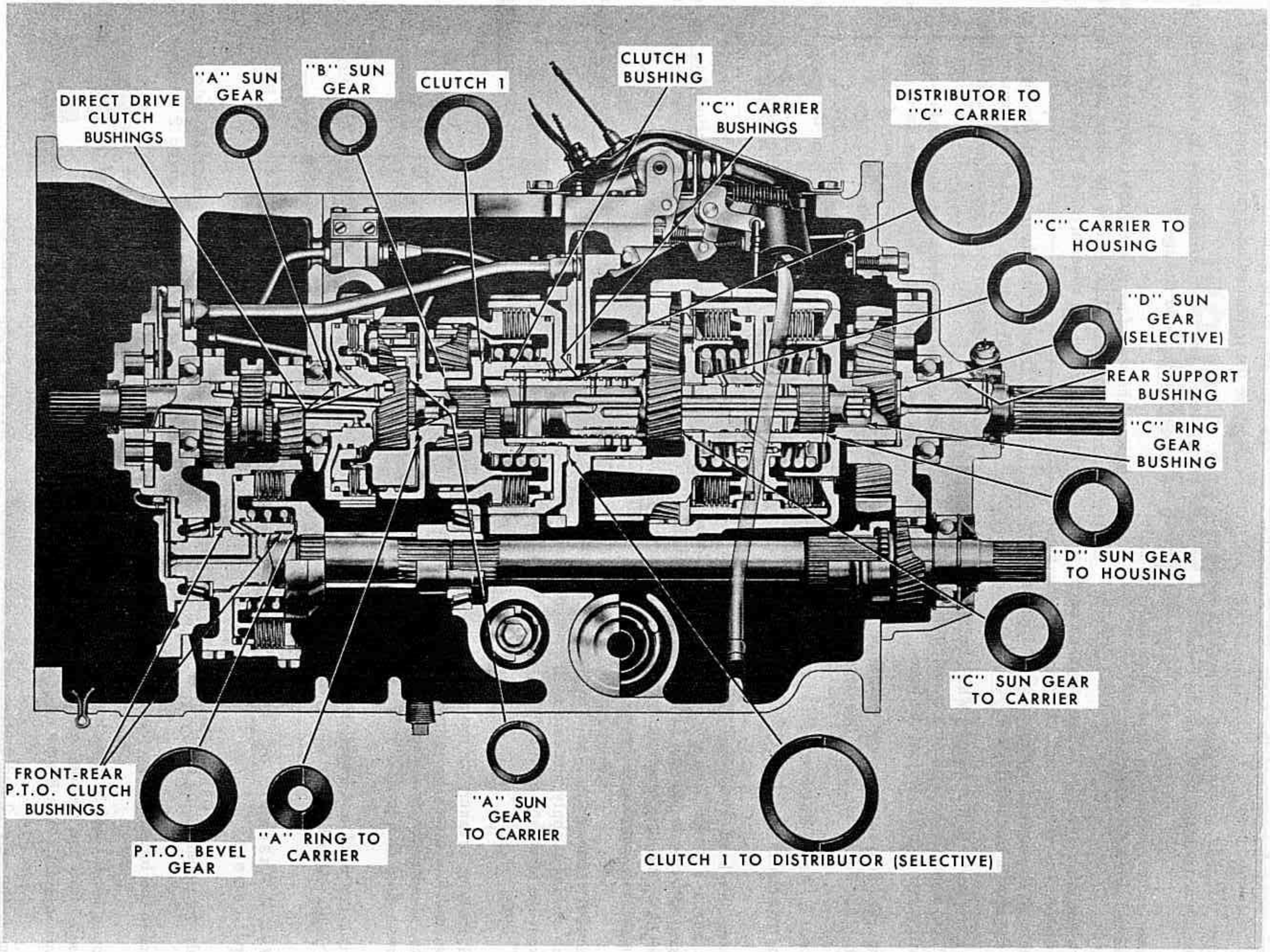


Figure 38
Thrust Washer and Bushing Locations

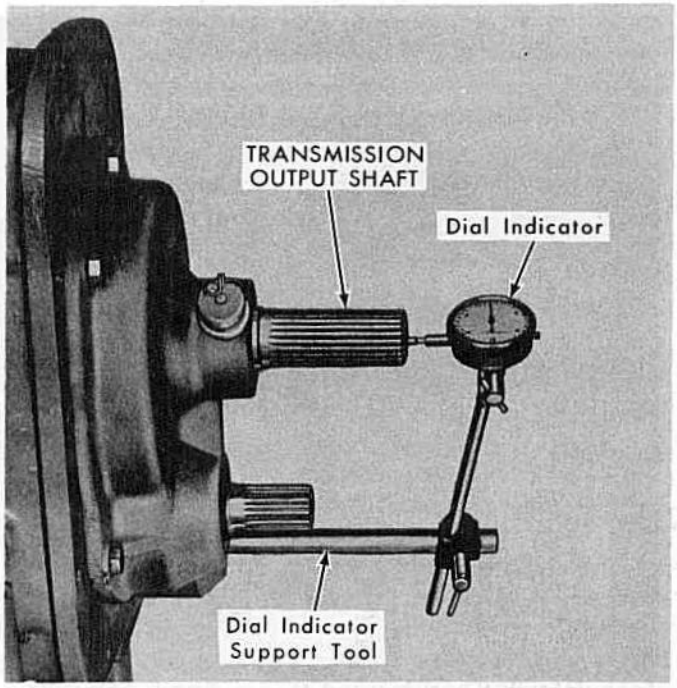


Figure 39
Checking Transmission Rear End Play

ASSEMBLIES SERVICED WITH THE TRACTOR SPLIT AT REAR OF TRANSMISSION

A. Separating the Center Housing from the Transmission

1. Drain the transmission fluid as covered on page 18.
2. Remove the traction disconnect inspection plate and the wire from the lube light sender switch.
3. Separate the center housing from the transmission as covered on page 168 of the Tractor Shop Manual, SE 8175, Removal and Installation.

NOTE: *When separating the transmission at the rear, it is important to note the way the disconnect coupling is positioned on the transmission output shaft. The coupling is properly installed when the long land is assembled toward the rear.*

B. Transmission End Play Checks

Variable thickness selective thrust washers, Figure 38, are used in the front and rear compartments of the transmission to permit proper end float of the components. The washers are available in .010" increment thicknesses, ranging from .062" to .122" for the front and .092" to .152" for the rear. The end play checks are to be noted and recorded prior to transmission disassembly. If improper end play readings are noted, the correct selective washer can be selected and used during reassembly.

CHECKING TRANSMISSION REAR END PLAY

1. Remove the transmission P.T.O. cable, speed selector assembly, filter, and safety starter switch, and the control valve, as covered on page 35, "Assemblies Serviced with Transmission Installed."
2. Back off the band 3 adjusting screw to completely release the band from the "C" carrier.
3. Mount the dial indicator support tool on the rear of the transmission case and install the dial indicator on the support so that the contact rests on the end of the transmission output shaft, as shown in Figure 39.
4. Push the output shaft toward the front of the transmission and set the dial indicator to zero, while maintaining a slight pressure on the shaft.

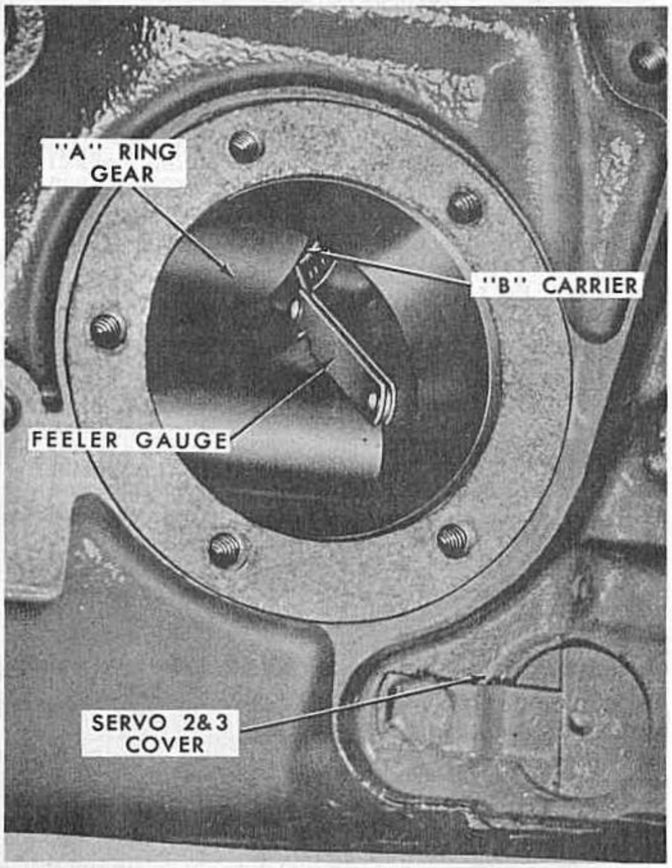


Figure 40
Checking Front End Play Through Inspection Cover

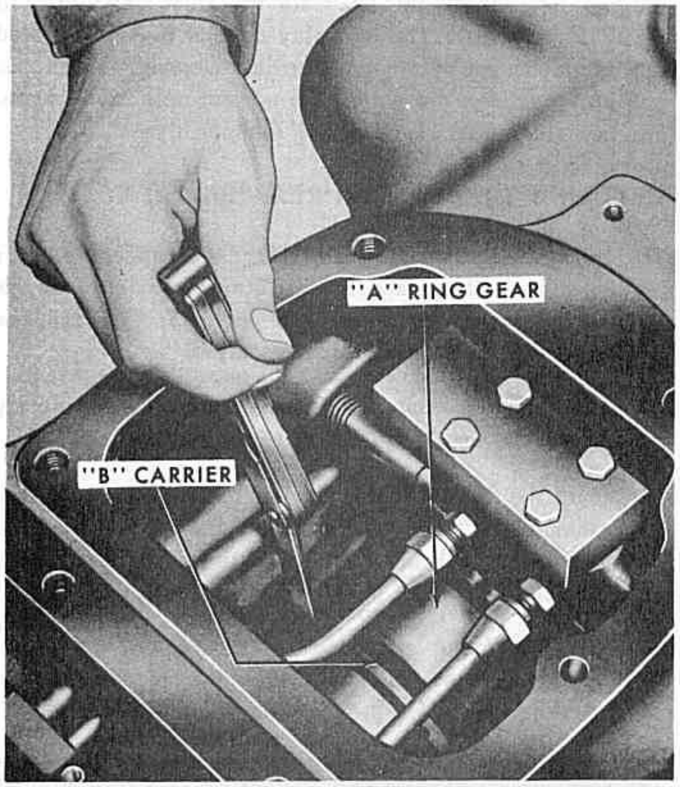


Figure 41
Checking Transmission Front End Play

5. Pull the output shaft rearward and record the dial indicator reading for reference during transmission assembly. Rear end play should be 0.005" to 0.015".

6. Remove the dial indicator and support tool from the rear of the transmission.

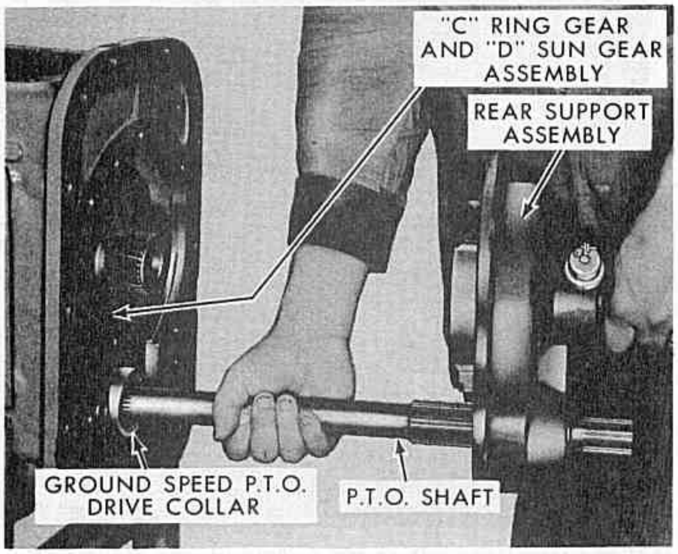

"C" RING GEAR AND "D" SUN GEAR ASSEMBLY
REAR SUPPORT ASSEMBLY
GROUND SPEED P.T.O. DRIVE COLLAR
P.T.O. SHAFT

Figure 42
Removing the Rear Support

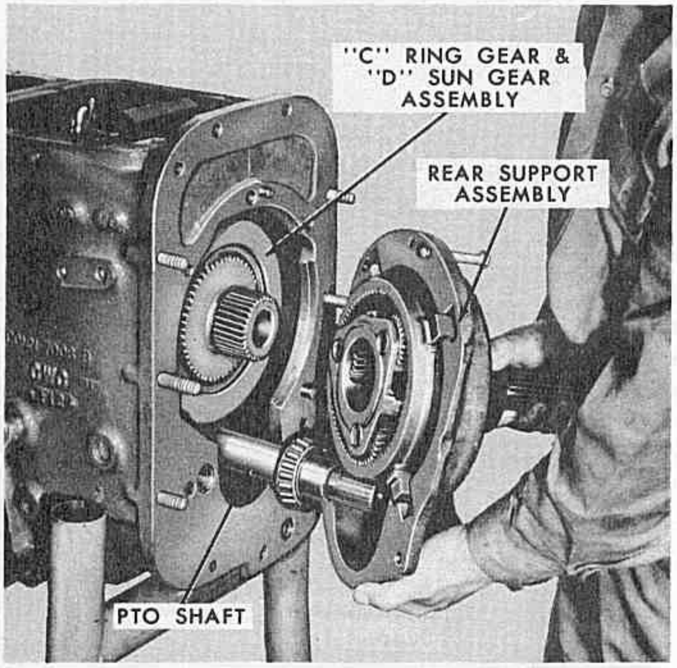


Figure 43
Removing the Rear Support (Single Speed P.T.O. Models)

CHECKING TRANSMISSION FRONT END PLAY

1. Back off band 2 adjusting screw to release band 2.

2. Remove the transmission right-hand inspection cover and pry the planetary "A" ring gear toward the rear of the transmission with a screwdriver and check the clearance between the "A" ring gear and the "B" carrier. See Figure 40.

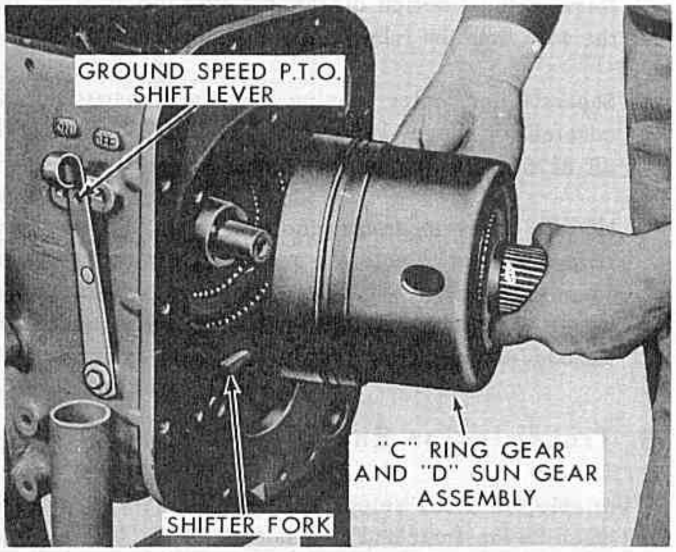

GROUND SPEED P.T.O. SHIFT LEVER
"C" RING GEAR AND "D" SUN GEAR ASSEMBLY
SHIFTER FORK

Figure 44
Removing the "C" Ring Gear and "D" Sun Gear

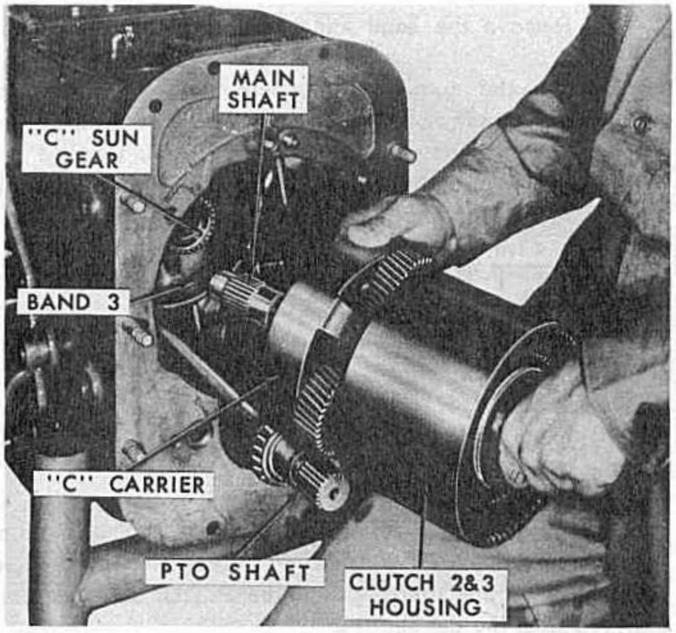


Figure 45

Removing Clutch 2 and 3 Housing and "C" Carrier

3. Insert the screwdriver between the "B" carrier and "A" ring gear and pry the ring gear toward the front of the transmission. Again check the clearance between these two units.

4. Record the difference between the two checks made with the thickness gauge. Front end play should be 0.005" to 0.015".

NOTE: *If the transmission is removed from the tractor or the steering housing has been removed, the end play can be checked through the front opening, as shown in Figure 41.*

C. Transmission Components – Removal

1. Remove the transmission P.T.O. cable, speed selector assembly, filter, and safety starter switch and the control valve, as covered on page 35, "Assemblies Serviced with Transmission Installed." Perform the Transmission End Play Checks, as covered in B. above.

2. Remove the five rear support attaching bolts. In the case of the two speed P.T.O. models, the upper bolt is secured by a nut and washer located on the inside of the case which holds the interlock linkage in place.

3. Install two 3/8" – 24 NF jack screws in the rear support to separate the support from the case. The P.T.O. shaft is removed with the support. See Figure 42.

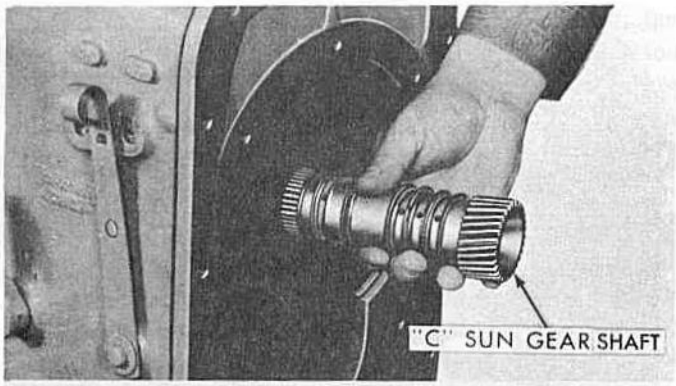


Figure 46

Removing the "C" Sun Gear Shaft

Single Speed P.T.O.: In the case of the single speed P.T.O. models, the P.T.O. shaft remains in the transmission. See Figure 43.

4. Remove the ground speed P.T.O. drive collar, shown in Figure 42, from the shifter fork.

5. Move the ground speed P.T.O. shift lever as required to locate the drive collar shifter fork in its lower position. Remove the "C" ring gear "D" sun gear assembly, as shown in Figure 44.

6. Loosen the No. 3 band adjusting screw and remove the clutch 2 and 3 housing, and "C" carrier and the mainshaft in one assembly, as shown in Figure 45.

   NOTE: *If the clutch housing is pulled away from the "C" carrier, breakage of the mainshaft seals can result.*

7. Remove the "C" sun gear as shown in Figure 46.

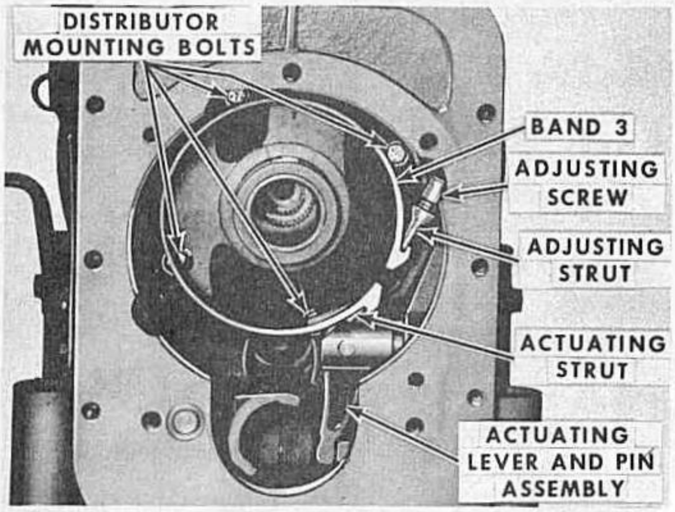


Figure 47

Band 3 in Position

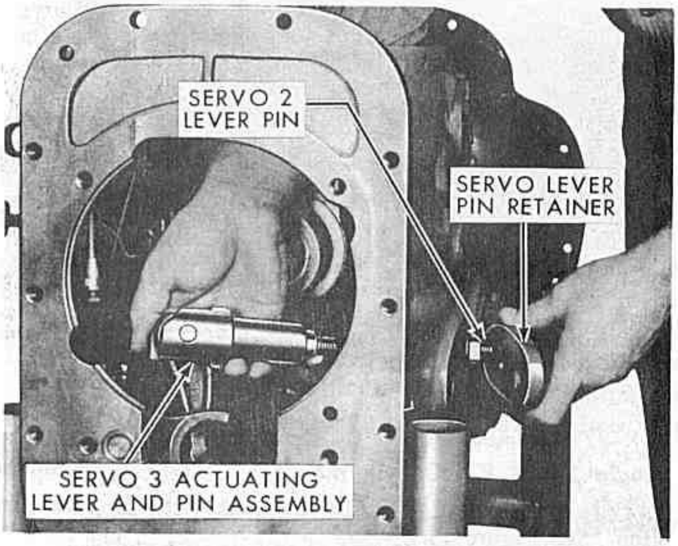


Figure 48
Removing the Servo Lever and Pin Assembly from Servo 3

NOTE: *At this point, the inching pedal and P.T.O. interlock linkage can be removed as covered in steps 20 through 22.*

8. Manually compress No. 3 band while holding the adjusting strut and actuating strut, shown in Figure 47. Remove the band and two struts from the case.

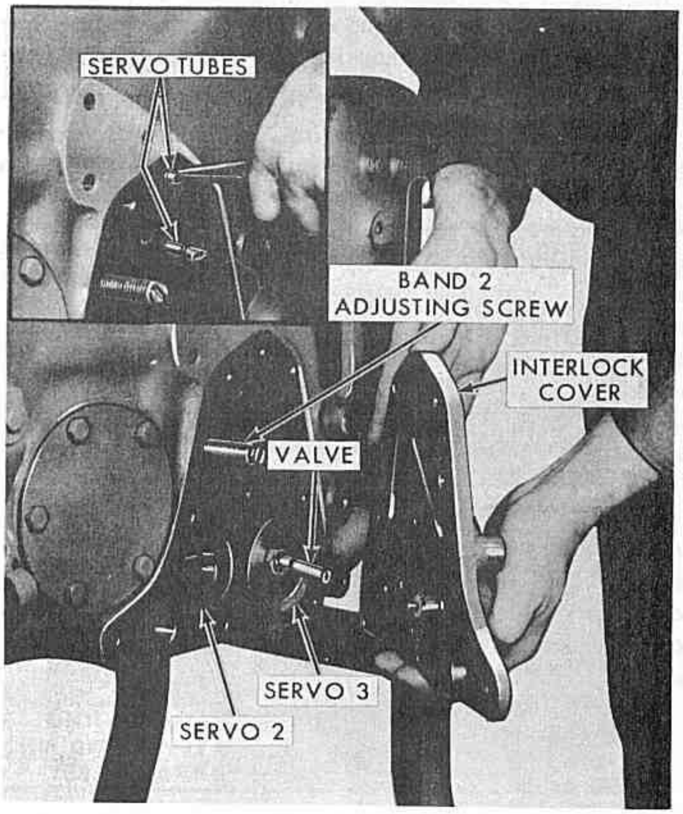


Figure 49
Removing the Servo Interlock Cover

9. Remove the nuts, flat washers, and bolt from the servo 2 actuating lever pin and servo 3 actuating lever pin. Remove the retainer. See Figure 48. Remove the servo 3 lever and pin assembly. Remove the adjusting screw by threading it down through the case.

Single Speed P.T.O.: Remove the nuts and flat washers from servo 2 and 3 actuating pins and remove the servo lever pin retainer. Move the servo pin to the right against the case and swing the lever rearward to free it from the servo piston rod. Remove the adjusting screw by threading it through the case.

If the transmission is to be completely disassembled, it may be advantageous to first remove the P.T.O. system as covered on page 45. Additional clearance is provided for removal of the distributor if the P.T.O. shaft is first removed from the case.

10. Remove No. 2 band adjusting screw lock nut and washer and loosen the adjusting screw. Remove the eight servo 2 and 3 cover attaching bolts and remove the cover and gasket, shown in Figure 49.

    NOTE: *No. 2 band must be completely free and the cover removed evenly to prevent damaging the valve attached to the servo 3 piston.*

11. Loosen the four distributor mounting bolts, shown in Figure 47, and remove the two servo tubes from the distributor (but not from the transmission case), by twisting and pulling at the same time, as shown in the Insert, Figure 49.

12. Disconnect the fitting that attaches the P.T.O. hydraulic fluid line to the distributor, as shown in Figure 50, and remove the four distributor attaching bolts.

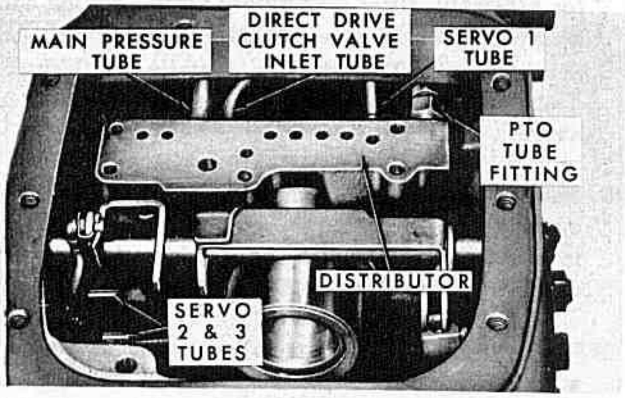


Figure 50
Fluid Lines to Distributor

13. Check to be sure that No. 2 band is loosened as much as possible. Move the ground speed P.T.O. shifter fork toward the rear, then pivot it up and out of the way.

14. Remove the distributor, clutch 1, "B" ring gear and "B" carrier as an assembly, as shown in Figure 51.

Single Speed P.T.O.: With the P.T.O. shaft installed, separate the distributor from clutch 1, making sure clutch 1 does not move rearward. This can be done by using a small blade screwdriver to pry the components apart. If additional holding effort on the clutch 1 assembly is required, reinstall the servo 2 and 3 cover and the servo pin retainer so that band 2 can be tightened on the drum. After the distributor has been separated from clutch 1, remove the retainer, pivot servo 3 actuating lever, and raise the distributor up and over the servo 3 actuating lever and pin assembly, as shown in Figure 52, and allow the lever to swing back into the servo piston rod. Remove clutch 1, "B" ring gear, and "B" carrier.

15. Remove the "B" sun gear and "A" ring gear, shown in Figure 53. The "A" carrier and direct drive clutch can now be removed from the transmission input shaft.

16. Loosen the No. 1 band adjusting screw, compress the band while holding the actuating strut, and remove the band and strut from the case.

17. Compress No. 2 band sufficiently to loosen and remove the adjusting strut and actuating strut. No. 2 band can be removed by rotating it around the center web of the transmission, as shown in Figure 54.

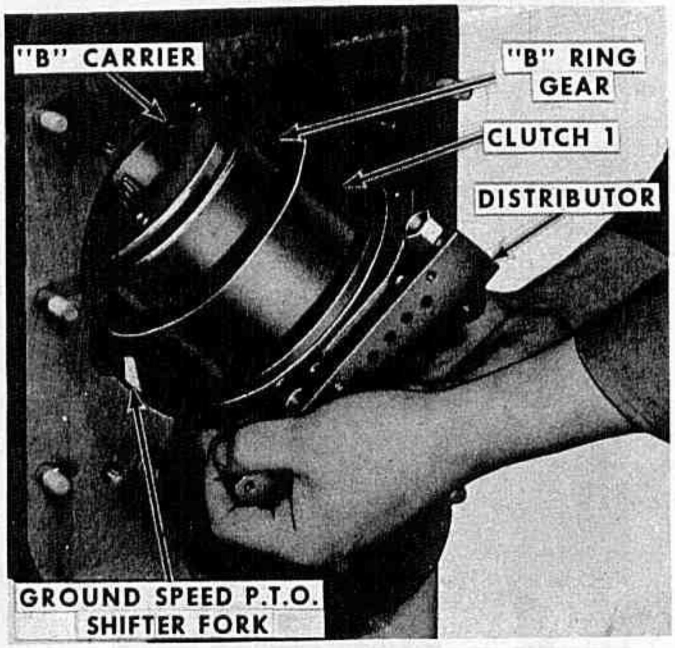


Figure 51
Removing the Distributor, Clutch 1, "B" Ring Gear and "B" Carrier

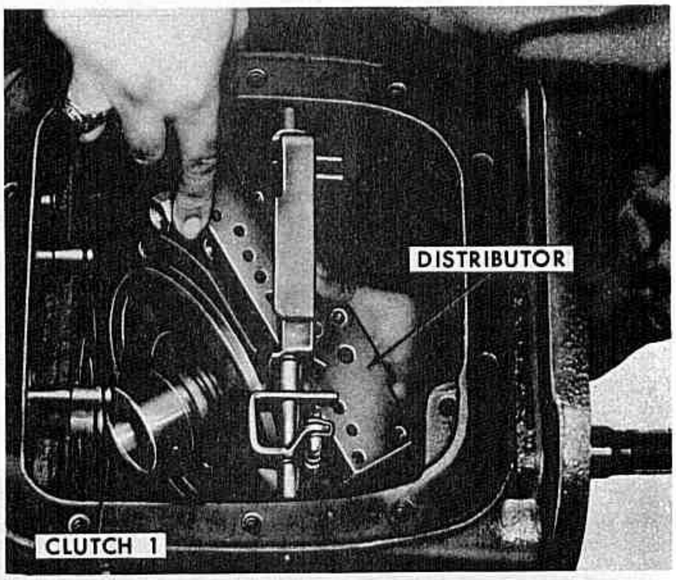


Figure 52
Removing the Distributor

18. Remove the servo 2 actuating lever and pin assembly from the transmission case. Refer to Figure 48.

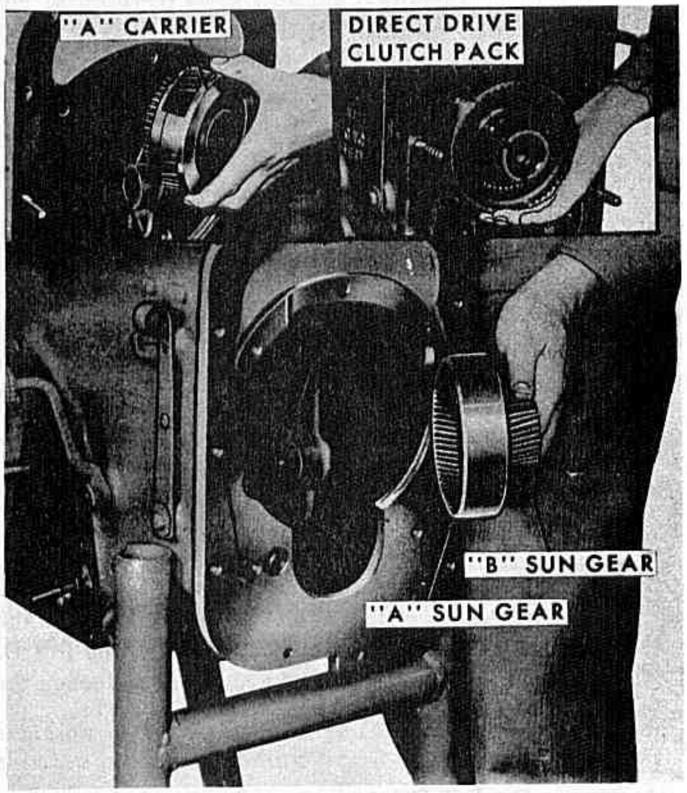


Figure 53
Removing the "B" Sun Gear and the "A" Ring Gear

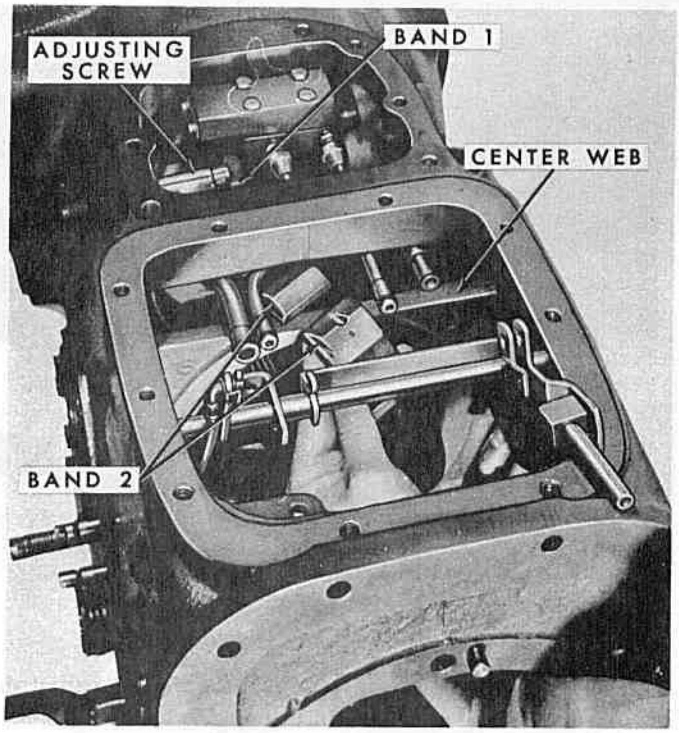


Figure 54
Removing Band 2

19. Remove the four servo 1 cover attaching bolts and remove the cover and servo from the right side of the transmission, as shown in Figure 55.

20. Remove the servo assemblies 2 and 3 from the left side of the transmission case.

21. Remove the guide and seal from the servo 2 bore, pulling it out with a suitable hooked tool.

22. Remove the roll pin that secures the inching pedal to the shaft and remove the pedal. Remove the upper and lower cotter keys and retaining clips from the inching pedal rod. See Figures 56 and 57. Remove the rod and the pedal shaft assembly from the case.

23. Remove the two snap rings from the feathering valve lever shaft. Drive the shaft to the right until the sealing plug is out of the case. For two-speed P.T.O. transmissions, it will also be necessary to loosen the interlock cable clamp.

24. Remove the P.T.O. interlock mechanism, ground speed P.T.O. shift lever, and the shifter fork, by removing the snap rings from the lever and fork shafts.

D. Transmission Components – Installation

1. Install the feathering valve lever shaft in the case with the transmission spacer and P.T.O. feathering control rocker and P.T.O. interlock assemblies. Secure with two snap rings. Install two sealing plugs, assembled tight against the shaft. Refer to Figure 57.

   NOTE: *Alignment of the feathering levers is performed with the valve body installed. Drive the shaft and sealing plugs to align the levers with the center of the feathering valve spools.*

2. Install the inching pedal shaft with "O" ring in the left side of the transmission case. Install the control rod with the retainer clips and cotter keys to the rocker shaft and to the pedal shaft. See Figures 56 and 57.

3. Install the inching pedal on the shaft and secure with the roll pin.

4. Install the ground speed P.T.O. shift lever and shifter fork securing the shafts with snap rings.

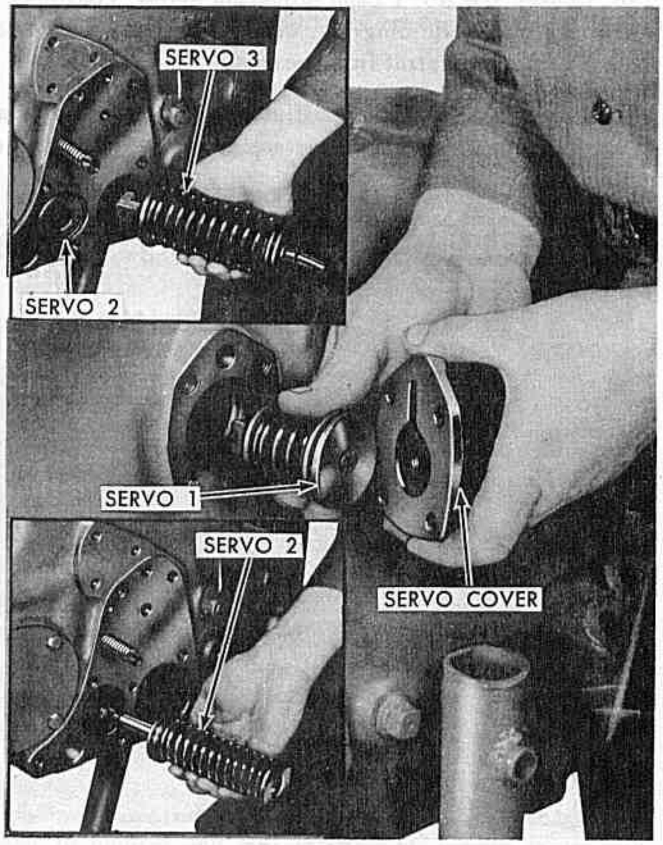


Figure 55
Removing Servos 1, 2, and 3

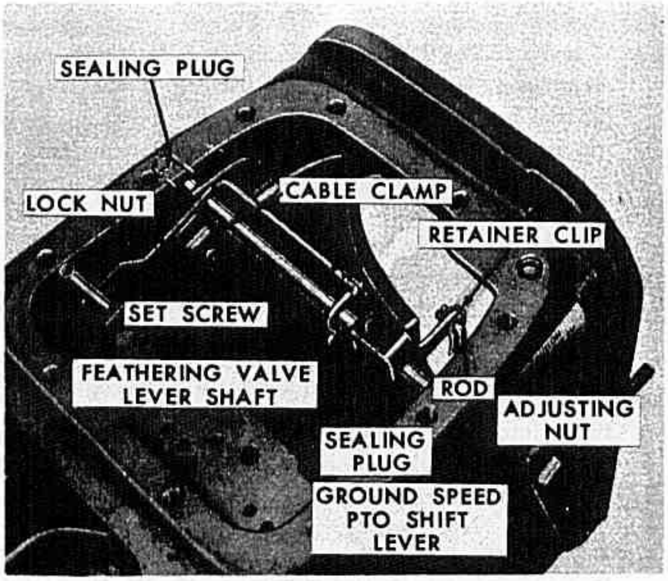


Figure 56
Feathering Linkage

5. Install the P.T.O. interlock cable and conduit in the case, inserting the top through the clamp in the feathering valve lever shaft linkage. The plunger on the bottom of the cable is installed in the shift shaft lever. Secure the conduit fitting to the lever. See Figure 57.

   NOTE: *The P.T.O. interlock cable must be adjusted after the control valve is positioned on the distributor. Refer to page 24.*

6. Assemble the bore and piston rod seal on the servo 2 rod and install the servo in the case with the notch forward, as shown in Figure 55.

7. Install the servo 2 actuating lever and pin assembly in the case. Place the lever in the notch of the servo rod. See Figure 48.

8. Install servo 3 assembly in the case with the notch rearward. Lift the inner end of the servo so that it is fully inward.

9. Install servo 3 actuating lever and pin assembly in the case. Place the lever in the notch of the servo rod.

10. Secure the servo 2 and 3 lever and pin assemblies with the retainer, one bolt, two washers, and two nuts.

   NOTE: *When assembling a single speed P.T.O. transmission with the P.T.O. shaft in place, leave step 10 until the distributor is installed.*

11. Install band 2 adjusting screw, flat washer, and lock nut. Rotate band 2 around the center web of the transmission and secure in position with the depression in the adjusting screw. See Figure 54. Join the band to the adjusting screw with the adjusting strut and to the servo lever with the actuating strut.

12. Install the "A" sun gear front thrust washer, Figure 38, over the rear of the input shaft and against the bearing. Position the "A" sun gear rear thrust washer in the "A" carrier and install the "A" carrier in the direct drive clutch. Install the direct drive clutch and the "A" carrier as an assembly on the input shaft.

13. Install band 1 over the direct drive clutch housing. See Figure 54. Install band 1 adjusting screw, sealing washer, and lock nut and secure the band with the adjusting screw and actuating strut, thin end toward the band.

14. Position the "A" ring–"B" sun gear thrust washer, Figure 38, over the rear of the input shaft and install the "A" ring – "B" sun gear. Then, place the "B" sun gear thrust washer in the hub of the "B" sun gear.

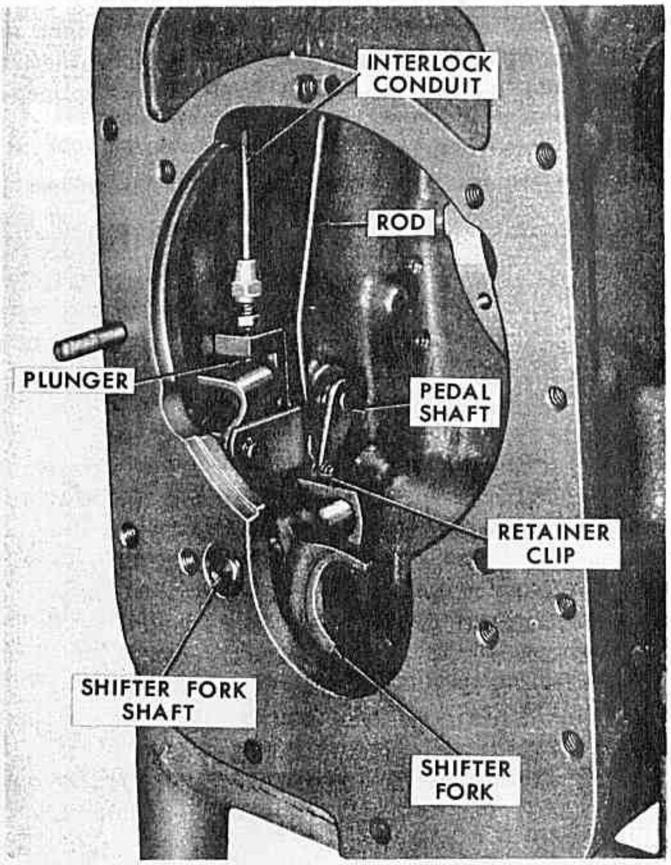


Figure 57
P.T.O. Interlock Linkage

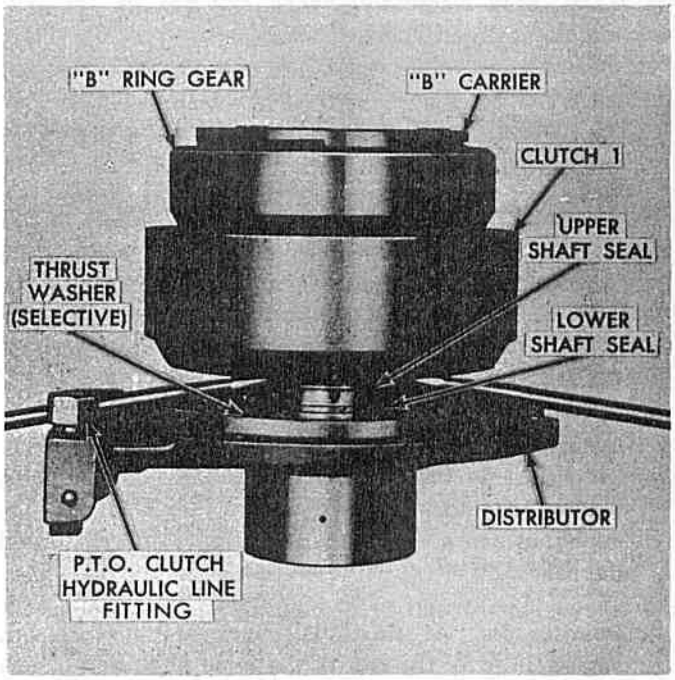


Figure 58

Installing the Distributor Shaft in Clutch 1

15. Position the clutch 1 thrust washer in place and assemble the "B" carrier into the clutch 1 assembly, aligning the "B" carrier splines with the splines in the clutch pack.

16. Install the "B" carrier and clutch 1 as an assembly, aligning the carrier pinions with the "B" sun gear.

17. Install the selective thrust washer, shown in Figure 38, over the distributor sleeve. Install and center the sleeve cast iron seals on the distributor, using Vaseline.

NOTE: *The seal with the square joint ends is forward. The seal with the step joint ends is closest to the distributor body.*

IMPORTANT: *If the transmission front end play was not within specifications when checked prior to disassembly, replace the selective washer with one of correct thickness.*

18. Install the distributor into the transmission case, inserting the sleeve with sealing rings into clutch 1.

Single Speed P.T.O.: It will be necessary to pivot servo 2 lever pin retainer to the rear to permit sufficient clearance for the distributor. See Figure 52.

19. Align the main pressure, direct drive clutch, and band 1 servo tubes with their respective openings in the distributor. Apply pressure to the distributor so that the sealing rings enter into the clutch housing. Install the four mounting bolts, but do not tighten securely at this time.

NOTE: *During assembly, it is important that clutch 1 is not pulled away from the "B" carrier causing the carrier not to be fully inserted and aligned with the clutch plates.*

20. Install and properly position the band 2 and 3 servo tubes into the distributor. See Insert, Figure 49. If the tubes are not aligned with the distributor, rotate the distributor as required and insert the tubes.

21. Tighten the distributor mounting bolts to 20 to 25 ft. lbs. torque. Attach the P.T.O. hydraulic line to the distributor fitting.

NOTE: *An alternate way of installing the distributor in two-speed P.T.O. models or in single speed P.T.O. models with the P.T.O. shaft removed, is to first install the clutch 1 "B" carrier as an assembly on the distributor, as shown in Figure 58. After the distributor is installed in the case, align the tubes and start the four distributor mounting bolts to draw the assembly in place.*

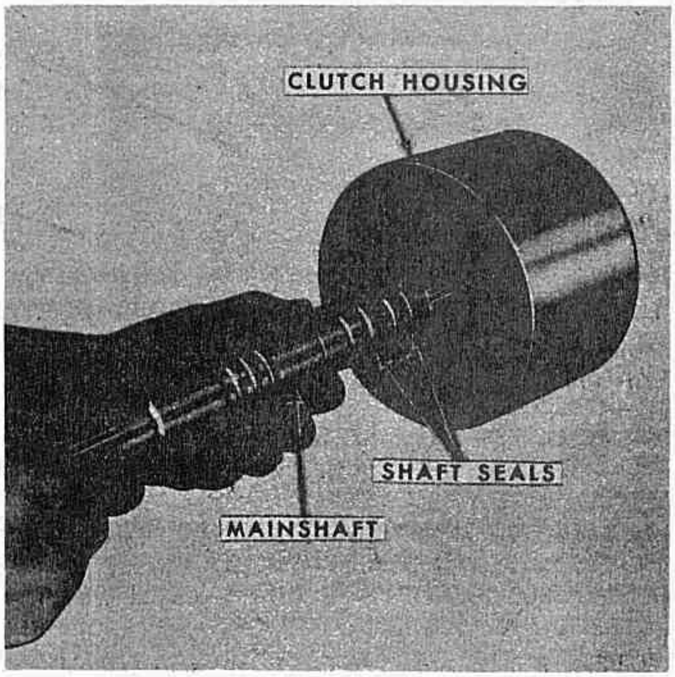


Figure 59

Installing the Mainshaft in the Clutch Housing

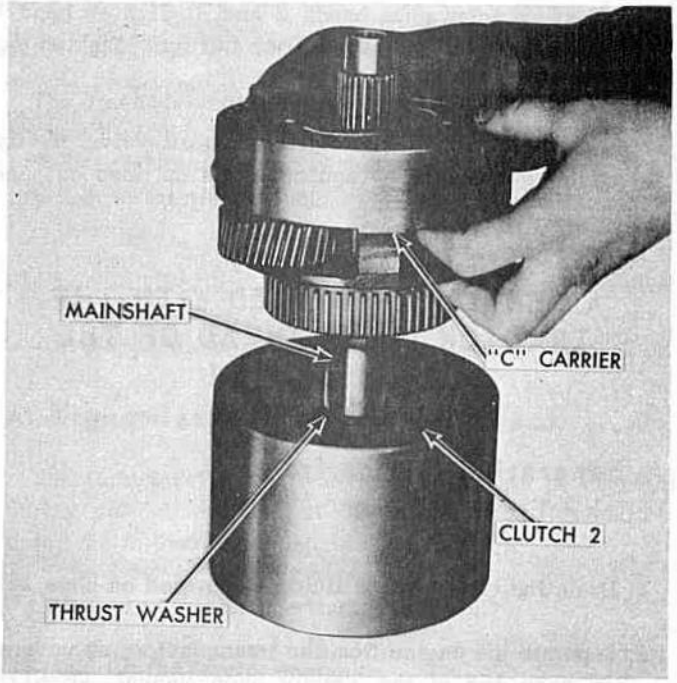


Figure 60
Installing the "C" Carrier in Clutch 2

22. Check the transmission front compartment end play as covered on page 41. If the end play is incorrect, it will be necessary to replace the selective washer with one of correct thickness. The end play should be .005" – .015". Lack of end clearance can be immediately detected by inserting the "C" sun gear into the distributor and into clutch 1 splines and noting if it is free to turn.

23. Install the six shaft seals on the "C" sun gear. Use Vaseline to center the seals. Insert the gear into the distributor so the splines align with the clutch 1 housing splines. See Figure 46. Install the thrust washer on the distributor rear journal.

24. Install band 3 adjusting screw and secure band 3 in position with the depression in the band end toward the adjusting screw. Join the band to the screw with the adjusting strut and to the servo lever with the actuating strut. See Figure 47.

25. Install the servo 2 and 3 cover and gasket, making sure the check ball pin for servo 2 is in place in the cover. See Figure 49. Install the strainer and plug assembly. Install and tighten the interlock cover attaching bolts evenly to 35–40 ft. lbs. torque. Install band 3 sealing washer and lock nut.

26. Install the three rearmost shaft seals on the mainshaft. Use Vaseline to center the seals. Install the shaft in the clutch 2 and 3 housing as shown in Figure 59. Position the "C" carrier to clutch housing thrust washer over the shaft.

27. Insert the "C" sun gear to "C" carrier thrust washer into the "C" carrier so it is positioned beneath the pinions. Install the "C" carrier over the end of the mainshaft, as shown in Figure 60. Align the "C" carrier splines with the clutch pack, rotating the carrier back and forth until it drops down into the clutch pack.

28. Install the remaining four shaft seals on the mainshaft. Use Vaseline to center the seals.

29. Install the mainshaft, "C" carrier, and clutch 2 and 3 housing as an assembly, inserting the forward end of the mainshaft into the "C" sun gear, as shown in Figure 45. Hold the "C" carrier to the clutch housing so separation does not take place, and gently move the complete assembly forward into band 3 until the splines on the mainshaft align with the "B" carrier splines.

30. Install the "D" sun gear-to-housing thrust washer on the end of the mainshaft with the counterbored side over snap ring on the end of the shaft.

31. Install the "C" ring – "D" sun gear over the clutch 2 and 3 housing assembly, first aligning the ring gear with the "C" carrier pinions and the mainshaft with the bushing in the "D" sun gear. Then, align the splines with the spline plates in clutch pack 3, rotating the "D" sun gear back and forth while applying pressure toward the clutch pack, as shown in Figure 61.

NOTE: *Do not pull the assembly to the rear as it is possible to separate the "C" carrier from clutch 2.*

32. Assemble the "D" carrier into the rear support with the "D" ring gear and install the rear selective thrust washer in the "D" carrier. See Figure 38.

IMPORTANT: *If the transmission rear end play was not within specifications when checked prior to disassembly, replace the thrust washer with one of correct thickness.*

33. Position the ground speed P.T.O. drive collar in the shifter fork and move the ground speed lever so that the fork is in the forward position. Install the "D" carrier, "D" ring gear, and P.T.O. rear shaft as an assembly with the rear support and new gasket. Refer to Figure 42. Insert the P.T.O. shaft through the shifter collar and align the forward end of the P.T.O.

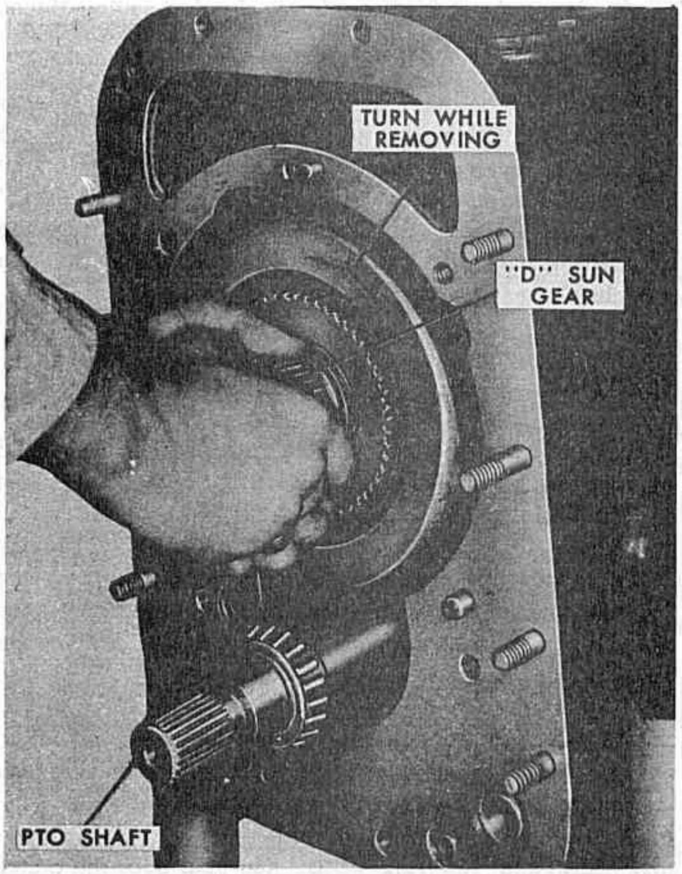


Figure 61
Installing the "C" Ring Gear and "D" Sun Gear

shaft with the spline in the front shaft rear bearing adapter. Align the "D" carrier with the "D" sun gear and the P.T.O. shifter collar splines to the splines on the rear of the P.T.O. shaft.

Single Speed P.T.O.: Install the "D" carrier and "D" ring gear as an assembly with the rear support and new gasket. Align the P.T.O. shaft with the rear support and the "D" carrier with the "D" sun gear.

34. Install the five rear support-to-case mounting bolts and secure the ground speed interlock linkage, located on the inside of the case with a nut and washer on the top rear support bolt. Tighten the bolts to 35–40 ft. lbs. torque.

35. Check the transmission compartment end play as covered on page 40. If the end play is incorrect, it will be necessary to replace the selective washer with one of correct thickness. The end play should be .005" to .015".

36. Adjust the transmission bands by fully tightening the adjusting screws for bands 2 and 3. Tighten band 1 adjusting screw and back off one full turn. Tighten the lock nuts.

37. Assembly of the transmission control valve, safety starter switch, filter, and cover, is outlined on page 35.

ASSEMBLIES SERVICED WITH THE TRACTOR SPLIT AHEAD OF THE TRANSMISSION

A. Separating Engine from the Transmission

1. Drain the transmission fluid, as covered on page 18.
2. Separate the engine from the transmission, as covered on page 168 of the Tractor Shop Manual, SE 8175, "Removal and Installation."
3. If required, remove the transmission cover and control valve as outlined on page 35.

B. Transmission Components – Removal

1. Remove the pump, Figure 62, and gasket by removing the four mounting bolts. Tap the pump with a soft-faced hammer and slide it from the input shaft.

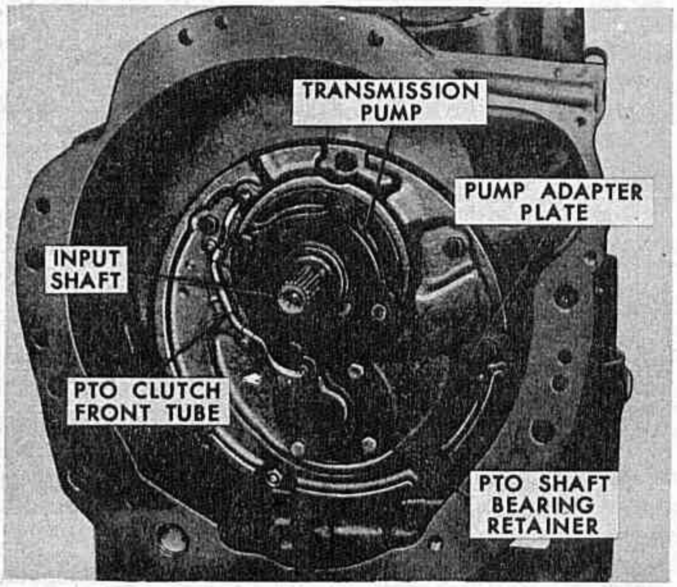


Figure 62
Front End of Transmission

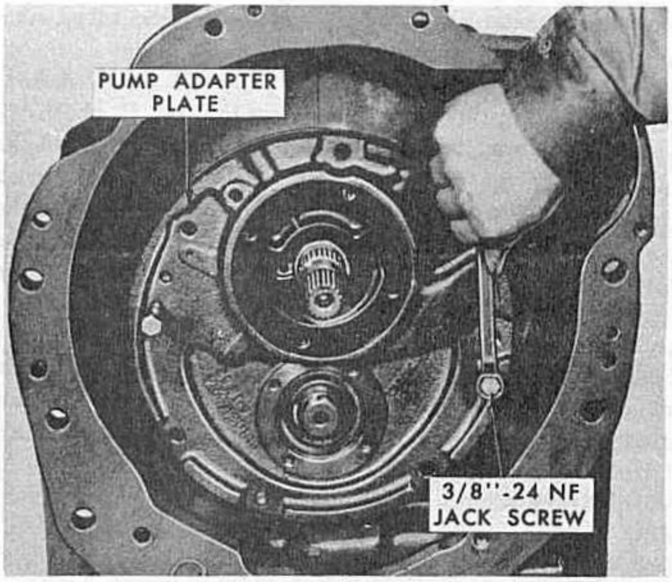


Figure 63
Removing Pump Adapter Plate

2. Remove the two screws which secure the P.T.O. clutch front tube to the adapter plate, and remove the line by pulling outward.

3. Remove the P.T.O. shaft bearing retainer, by removing the four securing bolts. Note the "O" ring and the shim pack which is used to adjust P.T.O. shaft preload.

4. Remove the six bolts and one nut securing the adapter plate to the case. Remove the plate by using two 3/8" – 24 NF jack screws, as shown in Figure 63.

NOTE: *Hold the input shaft in place as it is possible to drop the thrust washer between the "A" carrier and "A" ring gear if the shaft is moved forward.*

5. Remove the front P.T.O. shaft from the clutch pack on two-speed P.T.O. models by prying between the washer and clutch housing and pulling the shaft forward, as shown in Figure 64. Removing the transmission side inspection cover will aid shaft removal.

6. Remove the main pressure tube and front direct drive clutch tube by pulling the tubes forward and out of the case. Refer to Figure 64.

7. Service the P.T.O. clutch tube and front "O" ring by first disconnecting the fitting at the front of the distributor pulling the tube forward.

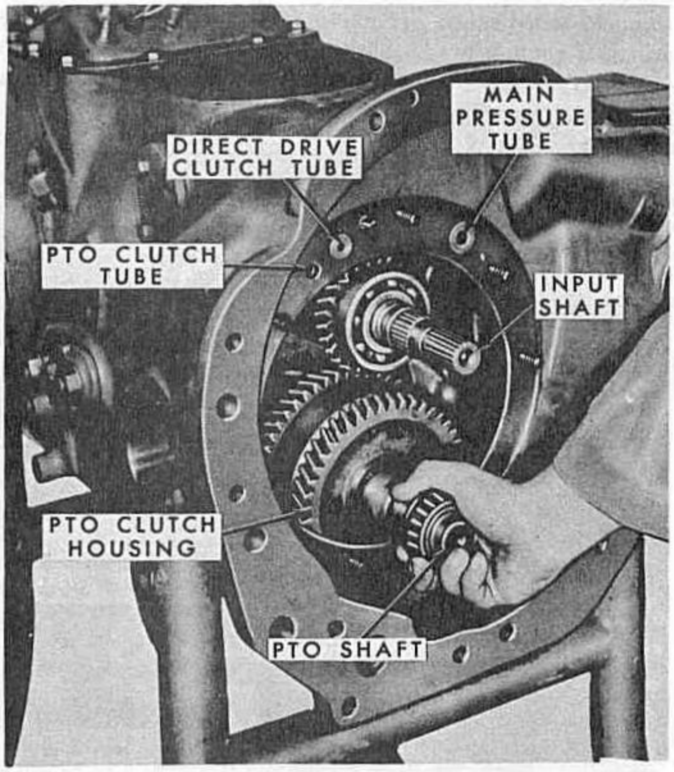


Figure 64
Removing Front P.T.O. Shaft

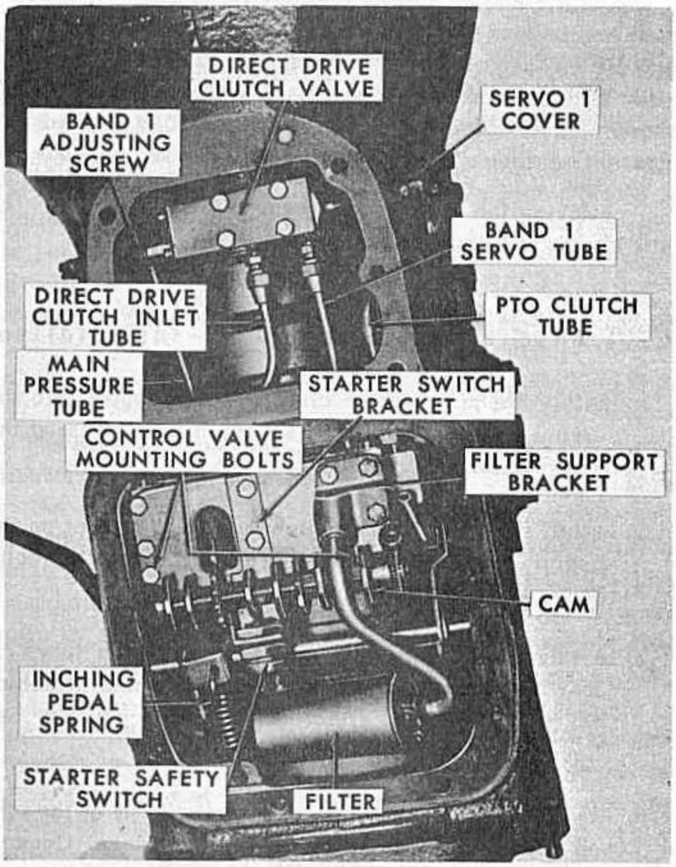


Figure 65
Transmission Cover Removed

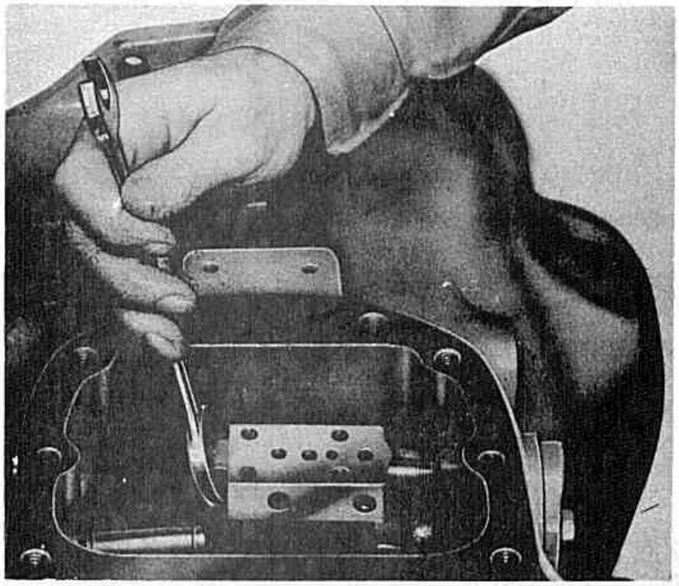


Figure 66

Removing the Direct Drive Clutch Valve Support Block

8. Remove the direct drive clutch valve by removing the four bolts securing the valve to the support. See Figure 65.

9. Remove the rear direct drive clutch tube and servo 1 tube by disconnecting the fittings and pulling the tubes forward.

10. Remove the direct drive clutch valve body support by removing the fittings and using a 3/4" end wrench as shown in Figure 66.

C. Transmission Components – Installation

1. Install the direct drive clutch valve support into the servo 1 opening in the transmission case. Thread the fittings into the support.

2. Install the direct drive clutch valve and gasket on the support using the four mounting bolts. Tighten the bolts to 6 – 8 ft. lbs. torque.

3. Install the servo 1 and direct drive clutch tubes by inserting the tubes into the distributor and attaching the fittings at the direct drive clutch support. See Figure 65.

4. Assemble the P.T.O. "O" ring on the front of the tube and press the tube rearward into the case. Connect the P.T.O. fitting at the distributor.

5. Install the "O" rings on the main pressure and front direct drive clutch tubes and install the tubes from the front of the case.

6. Install the three shaft seals on the P.T.O. shaft and center them, using Vaseline. Install the shaft in the front of the clutch housing while at the same time holding the P.T.O. hub. See Figure 64. Through the cover opening install the spacer and rear bearing adapter on the shaft as it is inserted through the housing.

7. Install the two front input shaft seals and center them, using Vaseline. Install the pump adapter plate and gasket as shown in Figure 67, and secure with six bolts and one nut. Tighten the bolts to 25 – 30 ft. lbs. torque.

8. Inspect to see that the front P.T.O. bearing cup is in position and mount the front P.T.O. bearing retainer with the shim pack and "O" ring removed. Install and tighten the mounting bolts to 12 – 15 ft. lbs. torque.

9. Install the pump with gasket over the input shaft, being careful not to damage the seal. Install and tighten the bolts to 15–18 ft. lbs. torque.

10. Install the P.T.O. clutch fluid line by inserting the ends, with new "O" rings, in the adapter plate and P.T.O. retainer. Lightly tap the tube ends to be sure they are fully seated. Secure the tube with two screws.

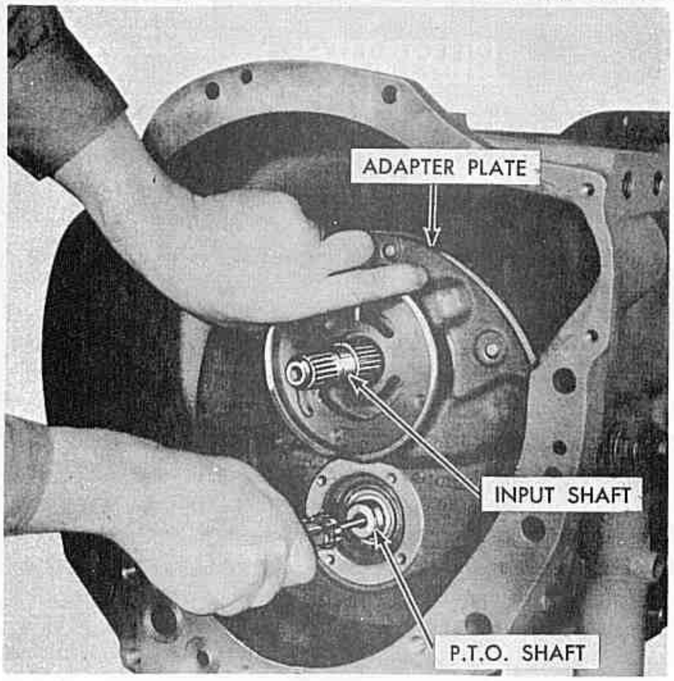


Figure 67

Installing the Adapter Plate

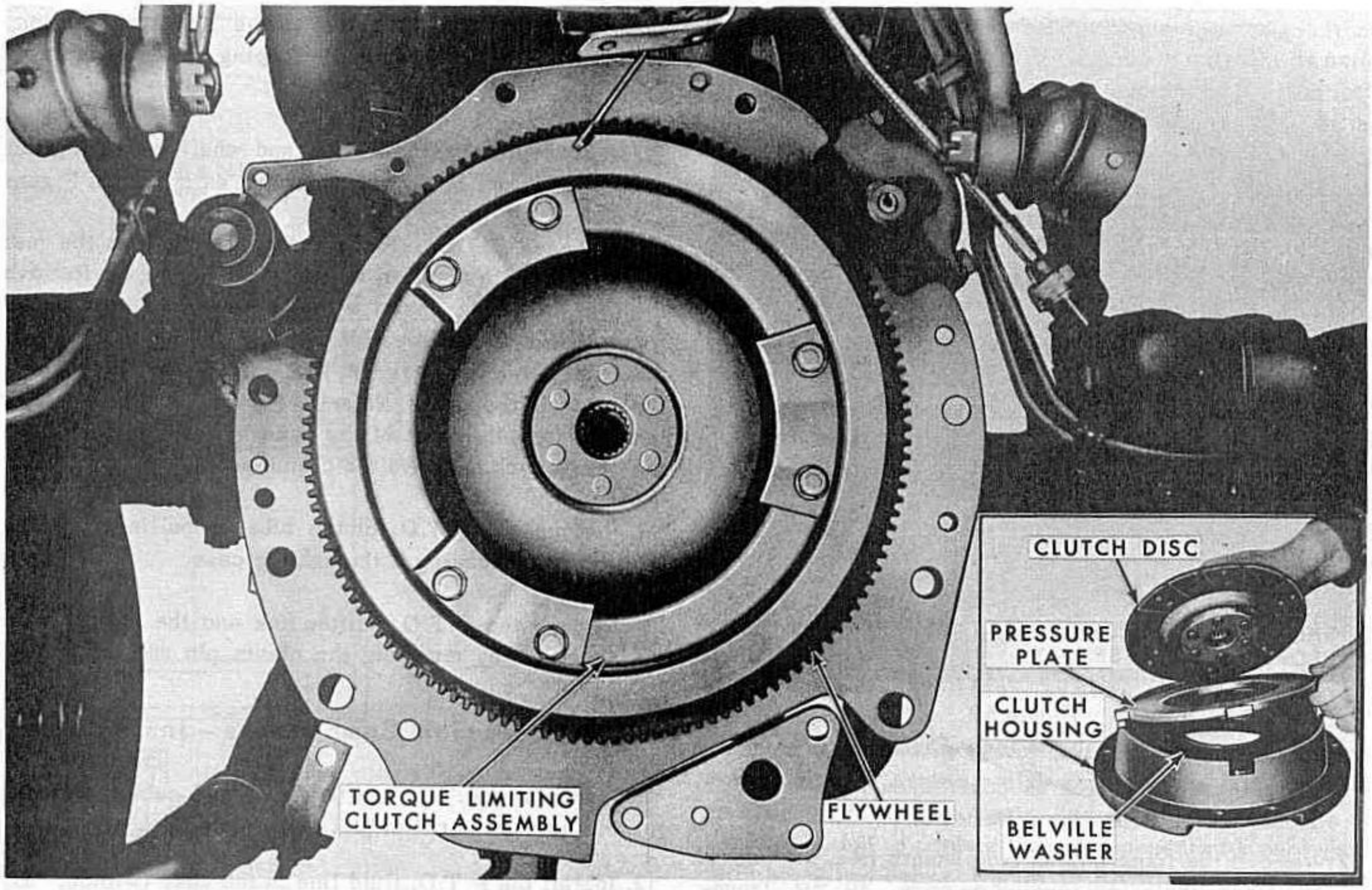


Figure 68
Torque Limiting Clutch Assembly

D. Torque Limiting Clutch – Replacement

1. Remove the six bolts securing the clutch housing to the engine flywheel while, at the same time, holding the housing so it does not drop from the flywheel. See Figure 68.

2. Remove the clutch housing, spring washer, pressure plate, and clutch disc.

   NOTE: *The hub of the disc is piloted in the flywheel for proper positioning. Note that the spring washer is assembled with the cup side forward to the pressure plate.*

3. The clutch is assembled in reverse of the above disassembly procedure.

ASSEMBLIES SERVICED WITH THE TRANSMISSION REMOVED

The instructions covered in this section for removing and installing the transmission components are to be used in conjunction with the removal and assembly instructions covered in the preceding sections "Assemblies Serviced with the Tractor Split Ahead of the Transmission," page 49, and "Assemblies Serviced with the Tractor Split at the Rear of the Transmission," page 40.

A. Removing Transmission from the Tractor

1. Split the tractor at the front of the transmission by performing the instructions covered on page 49, "A. Separating Engine from the Transmission."

2. Split the tractor at the rear of the transmission by performing the instructions covered on page 40, "A. Separating the Center Housing from the Transmission."

3. Place the transmission on a suitable stand, as shown in Figure 72.

B. Transmission Components – Removal

1. Remove the transmission components from the rear of

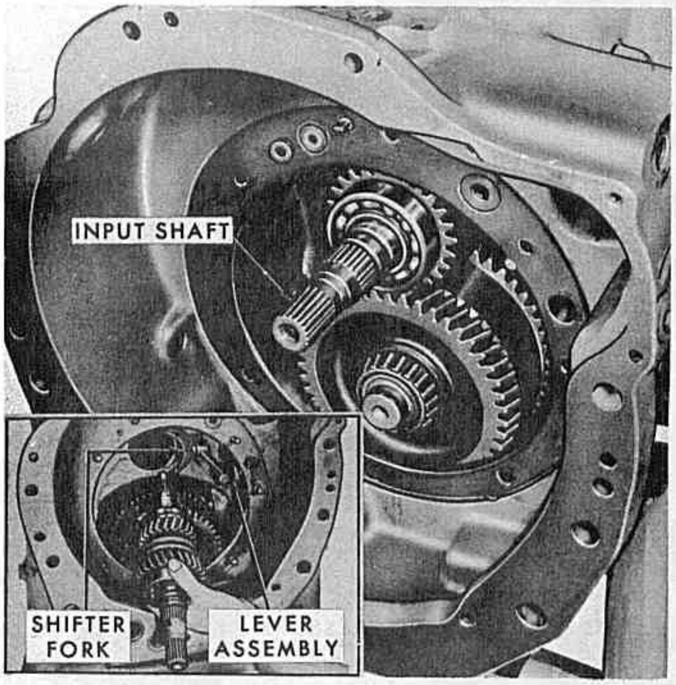


Figure 69
Removing the Input Shaft

the transmission case as covered on page 42, "C. Transmission Components Removal."

2. Remove the transmission components from the part of the transmission as covered on page 49, "B. Transmission Components – Removal."

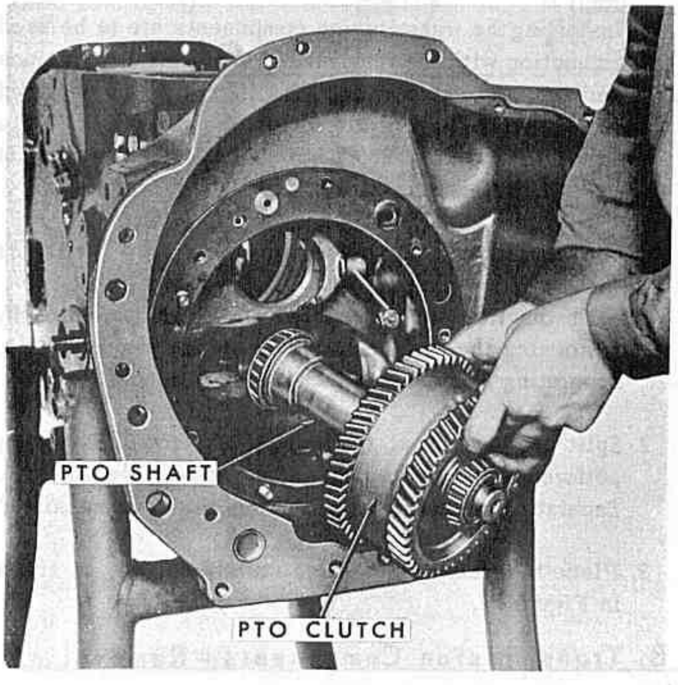


Figure 70
Removing the P.T.O. Clutch and Shaft

3. With the P.T.O. shift lever in the 1000 rpm position, remove the input shaft by tapping it forward. Refer to Figure 69.

4. Remove the P.T.O. clutch and shaft by lifting the assembly out of the transmission, as shown in Figure 70.

Single Speed P.T.O.: Remove the bearing from the rear of the shaft with a puller, as shown in Figure 71. Remove the rear snap ring. Insert a long screwdriver through the transmission side inspection opening and remove the half snap ring adjacent to the P.T.O. clutch pack by pushing the ring off the shaft. Refer to Figure 72. The shaft is removed from the front of the case by pushing it through the clutch pack. Remove the clutch pack.

5. Remove the P.T.O. clutch tube by pulling it to the rear and threading it through the case.

6. Remove the P.T.O. shifter fork and the shifter lever assembly by removing the clevis pin and cotter pin.

C. Transmission Components – Installation

1. Install the P.T.O. shifter lever and secure with the clevis pin and cotter pin. See Figure 73.

2. Install the P.T.O. fluid line in the case (without "O" ring) from the rear of the case and thread it into position. Push the tube through the front bulkhead, and assemble the "O" ring from the front. Press the tube into position.

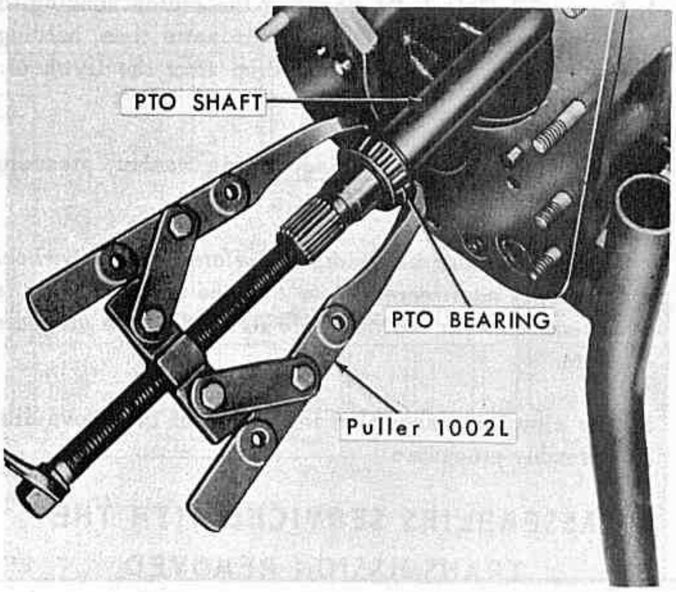


Figure 71
Removing the Rear P. T. O. Shaft Bearing

3. Position the thrust washer in the P.T.O. clutch pack and install the hub by rotating it back and forth to align the clutch plate splines.

4. Install three shaft seals on the P.T.O. shaft, centering them, using Vaseline. Install the shaft into the clutch housing while holding the clutch hub in position, as shown in Figure 74.

5. Install the spacer and rear bearing adapter and bearing on the shaft and install the complete assembly in the transmission case. See Figure 70.

Single Speed P.T.O.: Install the clutch pack assembled in step 3, into the transmission housing. Insert the P.T.O. shaft through the clutch, holding the clutch hub in position. Install the snap ring on the P.T.O. shaft through the transmission side inspection cover. Assemble the snap ring washer on the rear of the shaft and drive the tapered bearing against the washer, using a suitable tool.

6. Check the P.T.O. shaft preload as covered in "P.T.O. Shaft Preload Adjustment," page 55.

7. Place the P.T.O. shifter handle in the rear position and install the fork with the long finger up.

8. Install the four shaft sealing rings on the input shaft centering them, using Vaseline. Install the input shaft in the case, aligning the shift collar with the fork. Make sure the rear bearing of the shaft is fully pressed into the case.

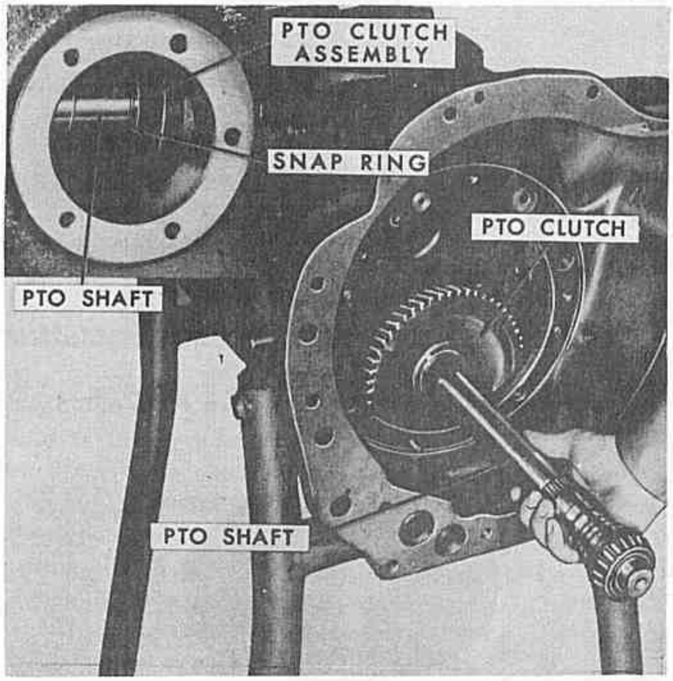


Figure 72
Removing the P.T.O. Shaft

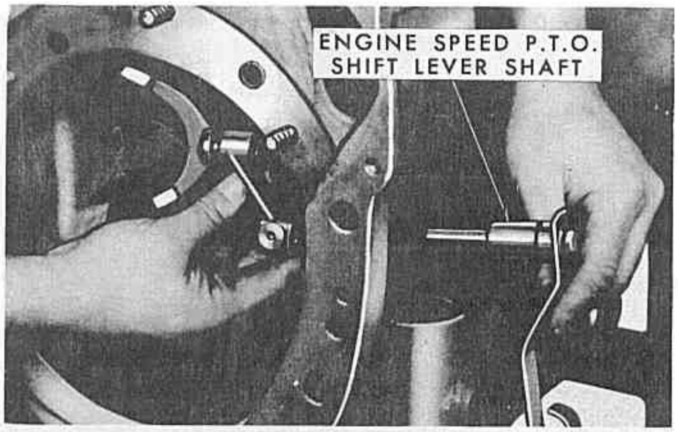


Figure 73
Installing the P.T.O. Shifter Lever

9. Install the pump adapter plate and gasket, holding the P.T.O. shaft up, as shown in Figure 67, and secure with six bolts and one nut. Tighten to 25–30 ft. lbs. torque.

10. Inspect to see that the front P.T.O. bearing cup is in position and mount the front P.T.O. bearing retainer with the correct shim pack and "O" ring. Install and tighten the mounting bolts to 12–15 ft. lbs. torque.

11. Install the pump with gasket over the input shaft, being careful not to damage the seal. Install and tighten the bolts to 15–18 ft. lbs. torque.

12. Install the P.T.O. clutch fluid line by inserting the ends with new "O" rings, in the adapter plate and P.T.O. retainer. Lightly tap the tube ends to be sure

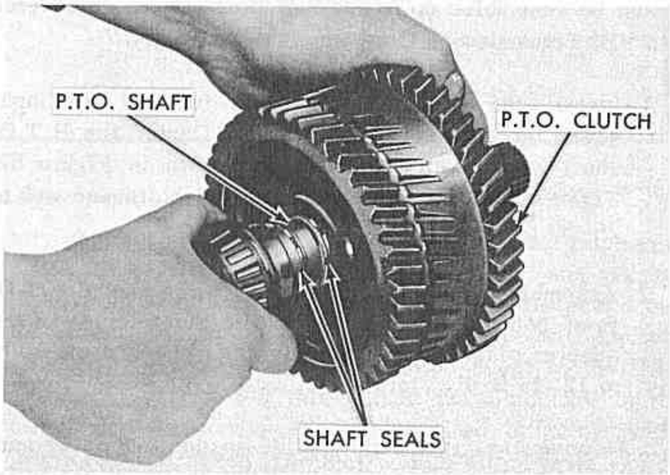


Figure 74
Installing the P. T.O. Shaft

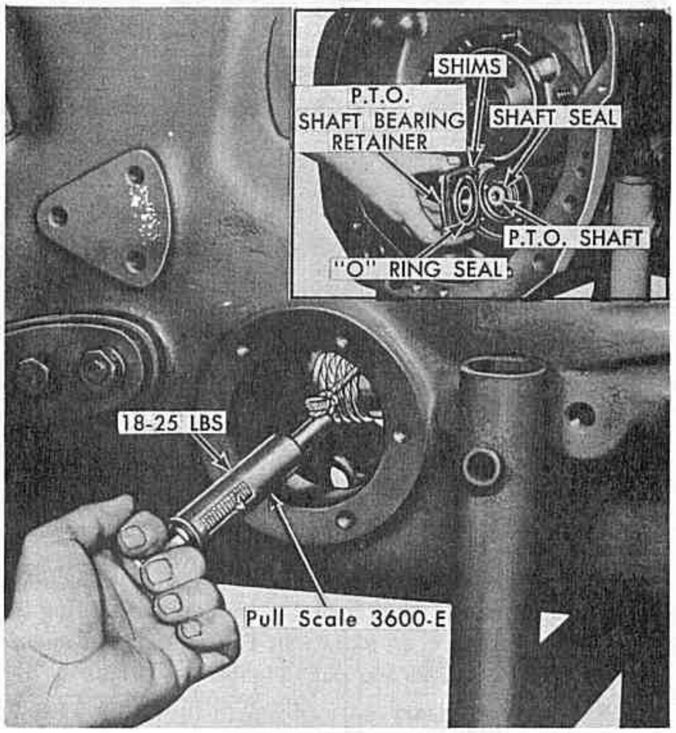


Figure 75
Checking P.T.O. Shaft Preload

they are fully seated. Secure the tube with two clips and screws.

13. Install the transmission rear components as covered on page 45, "D. Transmission Components – Installation."

D. P.T.O. Shaft Preload Adjustment

To perform the end play adjustment, the transmission must be assembled up to and including step 5, as covered in "B. Transmission Components – Assembly."

1. Install the front adapter plate (without the input shaft) and gasket on the case. Center the P.T.O. shaft with a suitable tool, as shown in Figure 67. Tighten the adapter plate mounting bolts and nut to 25–30 ft. lbs. torque.

2. Assemble the shim pack and "O" ring on the P.T.O. front bearing retainer and mount the retainer to the adapter plate. Install and tighten the mounting bolts to 12–15 ft. lbs. torque.

3. Remove the transmission side inspection cover and wrap a pull scale cord around the shaft, as shown in Figure 75. The shaft should rotate under a steady pull of 18–25 lbs. Adjust preload as required, using the .002", .003", .010" and .030" shims which are available at your Ford Tractor-Equipment Dealer.

Single Speed P.T.O.: In addition to steps 1, 2, and 3 above, it is necessary to have the transmission rear support cover and gasket installed without the P.T.O. shaft rear seal. Otherwise, the P.T.O. checking procedure is unchanged.

4. Remove the P.T.O. bearing retainer, being careful to keep the shim pack together. Remove the adapter plate.

Single Speed P.T.O.: Remove the transmission rear support and install the rear P.T.O. shaft seal.

5. Install the transmission input shaft and remaining transmission components, as covered in "B. Transmission Components – Installation," steps 7 through 13, page 53.

DISASSEMBLY, REPAIR, AND ASSEMBLY OF SUB-ASSEMBLIES

This procedure covers the disassembly, inspection, and assembly of the sub-assemblies removed from the transmission. Upon disassembly, all components should be

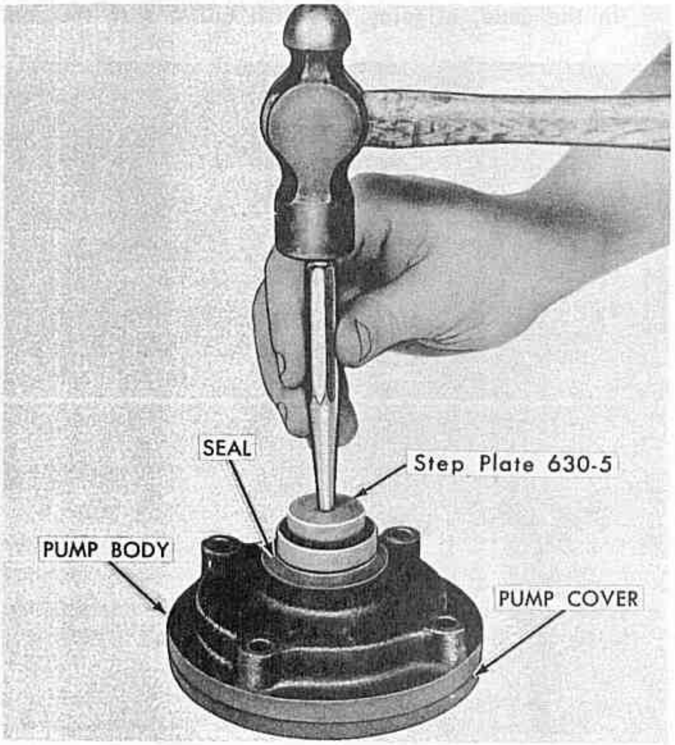


Figure 76
Servicing the Pump

examined for wear and damage. Some general areas to consider are:

Transmission case for cracks and servo bore wear.

Transmission case linkage for wear and misalignment.

Planetary pinions for indications of heat, pinion shaft turning and seizure, and broken teeth.

End movement of the pinions should not exceed .028".

Clutch packs for wear, heat distortion, and piston seizure.

Brake bands for indications of heat and wear.

Pump for scoring and wear.

Pump adapter plate for hairline cracks (pump area).

Shaft splines for wear and breakage.

Direct drive clutch and control valves for plunger action.

Condition of control valve cams.

Pressure tubes for damage and obstructions.

Bearings and bearing cups for wear and damage.

Shaft seals for wear by comparing with new parts.

Bushings for wear, indications of seizure and turning.

During the repair of assemblies, the following general instructions should be followed:

Thrust washers and shaft seals may be coated with Vaseline to facilitate assembly.

Handle all transmission parts carefully to avoid scoring or burring the bearing or mating surfaces.

Keep all parts and components clean by servicing these items with clean tools in clean surroundings, using lint-free wipers.

Remove all bearings and bearing races, using appropriate bearing and gear pullers. Be careful not to damage any adjoining components. When pressing on bearings, always make sure they are fully seated.

Always lubricate pinion bearings and bushings prior to assembly.

Use Lubriplate or Vaseline on all sealing "O" rings to facilitate assembly.

A. Pump Disassembly

1. Remove the two screws that attach the cover to the body and remove the cover.

2. Lift the rotor and rollers from the body. The transmission pump is serviced only as a complete assembly. Minor burrs or scores may be removed with crocus cloth.

3. Replace the seal in the pump with Step Plate 630-5, as shown in Figure 76.

4. If any part of the pump body, rollers, or rotor, are found to be defective, the complete pump assembly should be replaced.

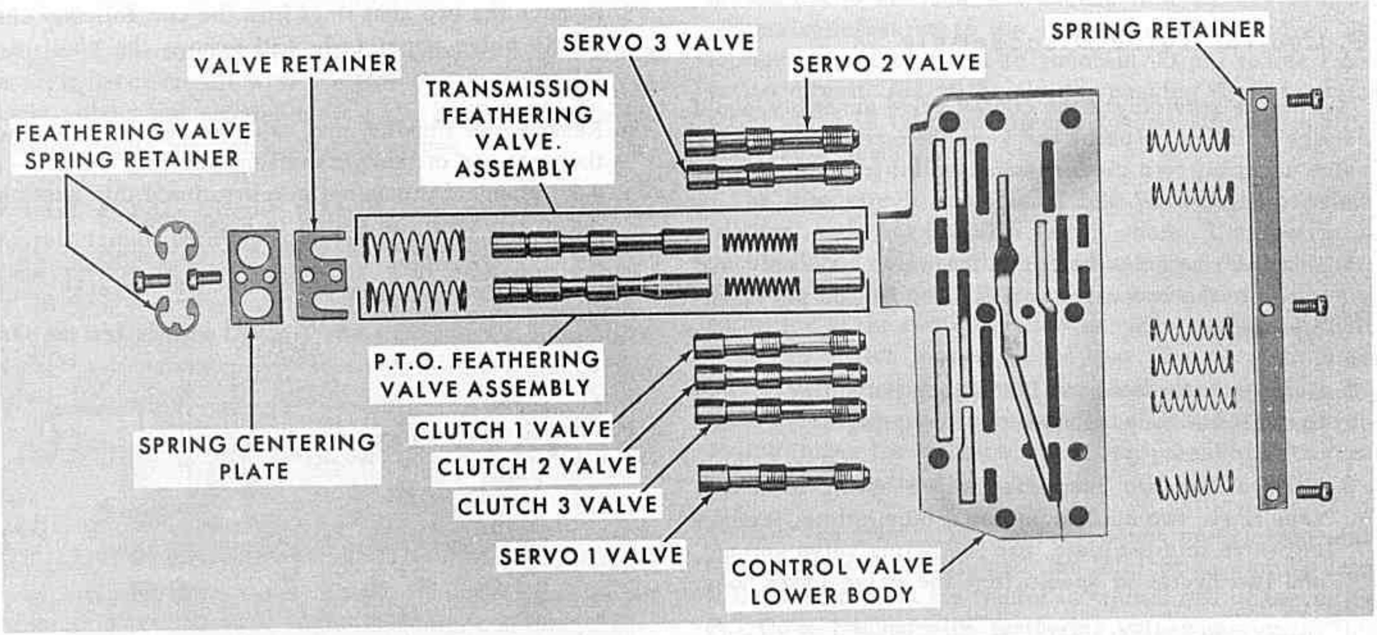


Figure 77
Control Valve Lower Body

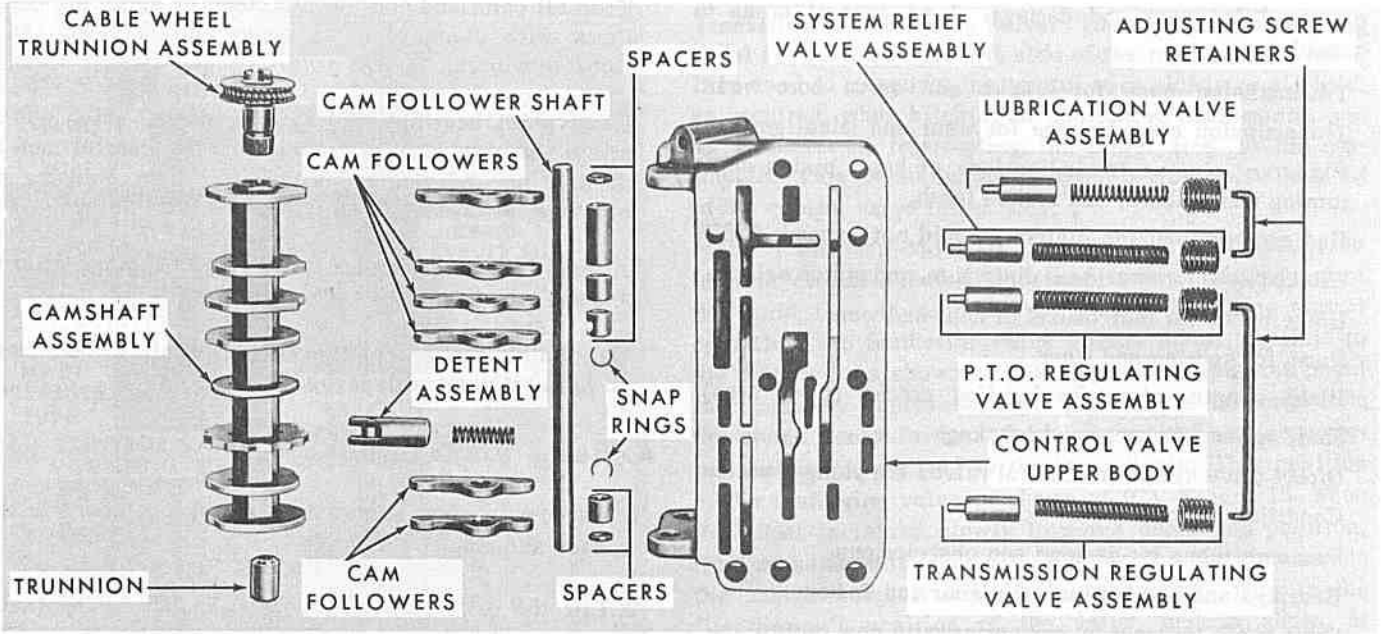

CABLE WHEEL TRUNNION ASSEMBLY
CAM FOLLOWER SHAFT
CAM FOLLOWERS
CAMSHAFT ASSEMBLY
DETENT ASSEMBLY
TRUNNION
CAM FOLLOWERS
SPACERS
SNAP RINGS
SPACERS
SYSTEM RELIEF VALVE ASSEMBLY
ADJUSTING SCREW RETAINERS
LUBRICATION VALVE ASSEMBLY
P.T.O. REGULATING VALVE ASSEMBLY
CONTROL VALVE UPPER BODY
TRANSMISSION REGULATING VALVE ASSEMBLY

Figure 78
Control Valve Upper Body

B. Assembly of Pump

1. Place the rotor and rollers in the pump housing.
2. Place a new "O" ring on the housing.
3. Secure the cover to the housing with two Phillips head screws.

C. Control Valve Disassembly

During the servicing of the control valve assembly, avoid damage to the valve parts, and keep them clean. Place the valve assembly on a clean chamois or lint-free shop towel. Refer to Figures 77 and 78.

1. Remove the bolts securing the valve assembly and separate the two valve bodies. Remove the six spool-type valves.
2. Remove the three screws that attach the spring retainer to the lower body. Remove the six springs.
3. Remove the two feathering valve spring retainers, snap rings, two springs, spring retainer plate, feathering valve retainer plate, two feathering valve springs, and two hydraulic spools, from the valve lower body.

NOTE: *The feathering valve spools are not interchangeable. The tapered land identifies the P.T.O. valve.*

4. Remove two adjusting screw retainers, four adjusting screws, four springs, and the four plunger-type valves from the valve upper body.

NOTE: *Steps 5 through 8 would not be necessary in an ordinary inspection procedure and are to be used only when damage or breakage is evident.*

5. Remove the two snap rings from the cam follower shaft in the valve upper body and remove the shaft, cam followers, and spacers.
6. Remove the trunnion and cable wheel assembly from the right end of the camshaft by inserting a 1/4" – 20 x 2" standard thread set screw to force this assembly out of the shaft, as shown in Figure 79.

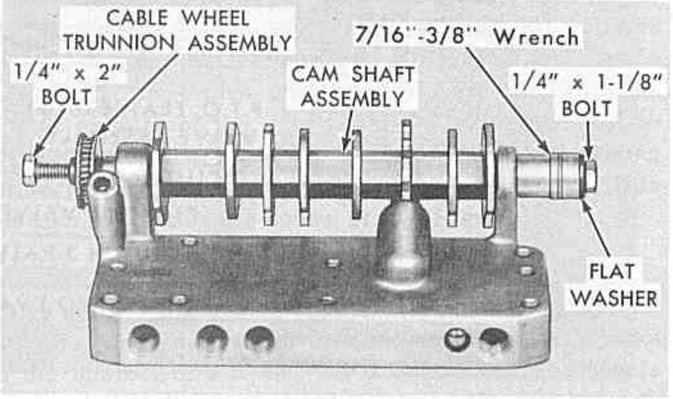


Figure 79
Removing the Cam Shaft Assembly

IMPORTANT: *Do not use a soft bolt for pulling this wheel as it will twist off. The threaded portion of the bolt must be at least 1-3/4" in length.*

7. To remove the trunnion from the left end of the camshaft, insert a 1/4" – 20 x 1-1/8" coarse thread, heat-treated bolt supported by a 7/16" x 3/8" drive, socket, and flat washer, and withdraw the trunnion from the shaft, as shown in Figure 79.

8. Remove the camshaft assembly and detent assembly from the control valve upper body.

9. Clean all parts thoroughly in clean solvent, then blow dry with compressed air.

10. Inspect all valve bores for scores. Check all fluid passages for obstructions. Inspect the mating surfaces for burrs or distortions. Examine the valves for burrs and scores.

NOTE: *Crocus cloth can be used to polish valves if care is taken to avoid rounding the sharp edges.*

11. Inspect all springs for distortion and check all of the valves for free movement in their respective bores.

D. Assembly of Control Valve

1. Arrange all parts in their proper position, as shown in Figures 77 and 78.

2. Position the camshaft assembly in the valve upper body. Insert a 3/8" bolt into the left end of the camshaft to support the assembly while the cable wheel and trunnion assembly is being pressed into the right end, as shown in Figure 80. A clearance of 0.015" should be maintained between the cable wheel and valve body, as shown. Press the trunnion into the left end of the camshaft, as shown in the Insert.

3. Install the valve springs, retainers, and all of the valves in the control valve upper and lower bodies. Rotate the spool valves when inserting them in their bores to avoid shaving the body casting.

4. Install the plunger valve springs and adjusting screws in the control valve upper body.

NOTE: *Turn the four valve adjusting screws into the valve body until they are flush with the front side. These valves must be adjusted under operating conditions with the transmission installed in the tractor. Refer to page 22. Then, the control valve assembly will have to be removed to permit locking these valves with the two retainers.*

5. Install the cam followers, spacers, and shaft in their respective positions on the valve upper body and secure the assembly with the two snap rings.

6. Position the upper body on the lower body. Align the bolt holes and loosely install the two bolts.

7. Align the upper and lower bodies by aligning the scribe marks on the ends of the bodies and tighten the bolts to 6–8 ft. lbs. torque.

E. Control Valve Alignment – Service Installed Parts

If a service control valve body is being used in conjunction with one which was removed from the transmission, it will be necessary to align the bodies as follows:

1. Position the upper body on the lower body. Align the bolt holes and loosely install the two mounting bolts.

2. Position the camshaft in the park (P) position (all valve spools out).

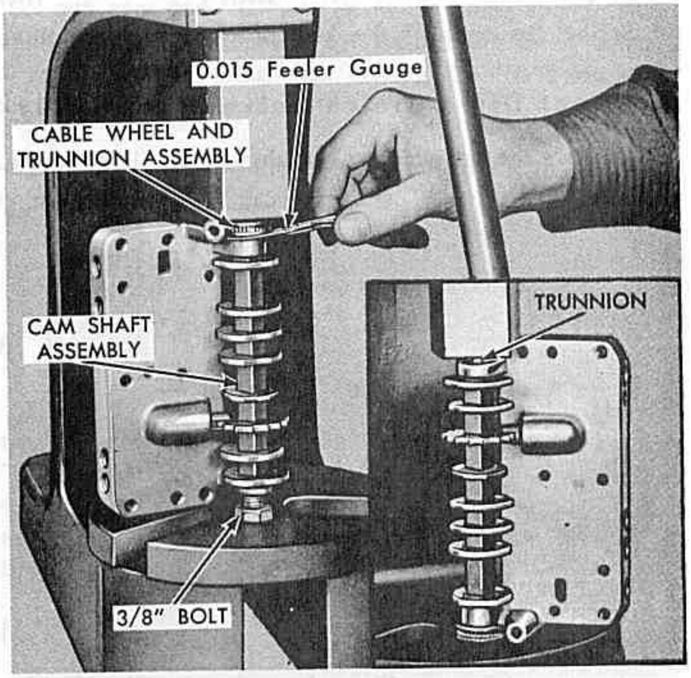


Figure 80
Installing the Cam Shaft Assembly

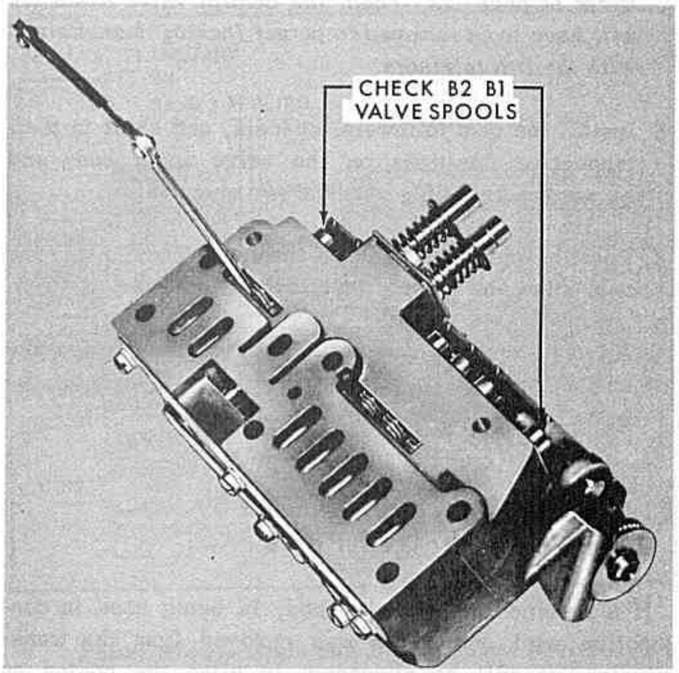


Figure 81
Valve Body Alignment

3. Insert a feeler gauge between the B2 and B1 spool lands and the side of the discharge ports in the lower valve body, as shown in Figure 81. The bodies should be positioned so that a clearance of .057" ± .010" is obtained. Tighten the securing bolts to 6–8 ft. lbs. torque.

4. Scribe the ends of the bodies for future servicing.

F. Direct Drive Clutch Valve Disassembly

1. Remove the two screws, end plate, stop plate, spring, and valve from the valve body, Figure 82.

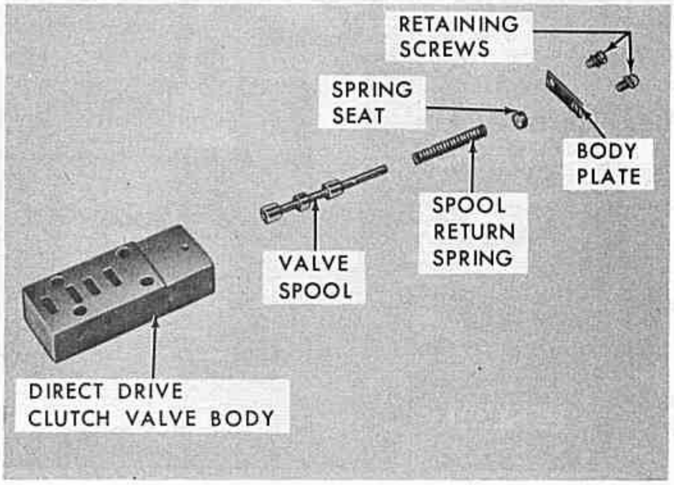


Figure 82
Direct Drive Clutch Valve Components

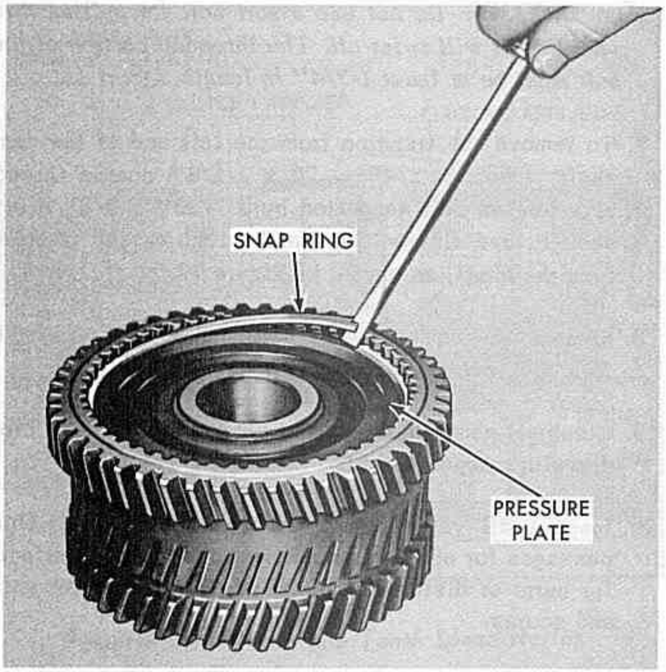


Figure 83
Clutch Snap Ring Removal

2. Clean all parts thoroughly in clean solvent, then blow dry with compressed air.

3. Inspect the valve and the valve bore for scores and burrs. Check the fluid passages for obstructions.

4. Check the spring for distortion and the spool for free

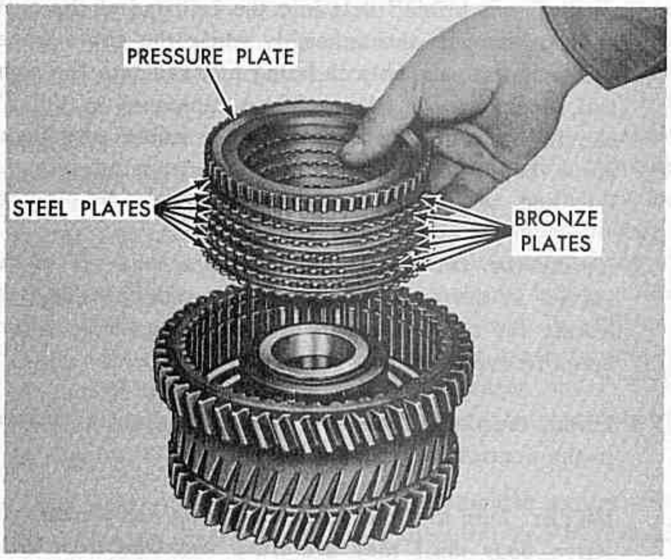


Figure 84
Removing the Clutch Plates

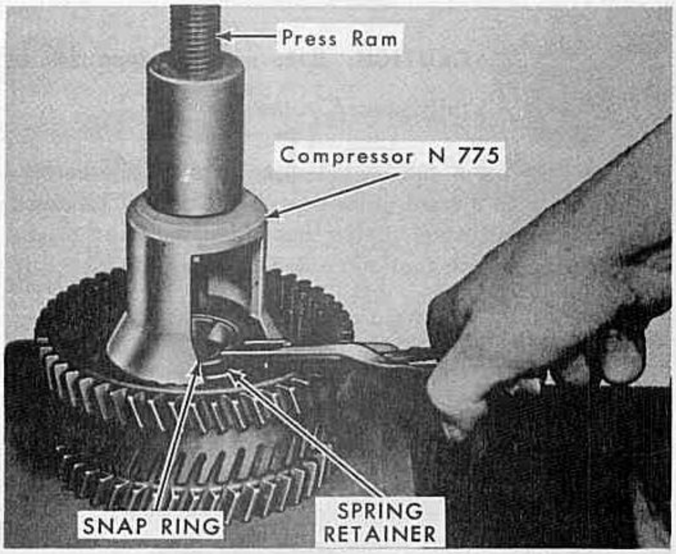


Figure 85
Clutch Spring Snap Ring Removal

movement in its bore. Crocus cloth can be used to polish the valve if care is used to avoid rounding the square corners.

G. Direct Drive Clutch Valve Assembly

Install the valve and spring into the valve housing. Then, install the stop plate and end plate and secure with two screws.

H. Clutch Pack Disassembly

The following procedure pertains to all clutch packs in the transmission with the exception of the direct drive clutch. For purpose of illustration, the P.T.O. clutch assembly will be shown.

When servicing clutch assembly 2 and 3, it will be necessary to remove the snap ring at the rear of the mainshaft and remove the mainshaft from the clutch assemblies.

1. Remove the clutch pressure plate snap ring, as shown in Figure 83.

   NOTE: *In clutch 1, the "B" ring gear is splined to the clutch housing, secured with a snap ring, and functions as a pressure plate.*

2. Remove the pressure plate and bronze and steel plates from the clutch housing, shown in Figure 84.

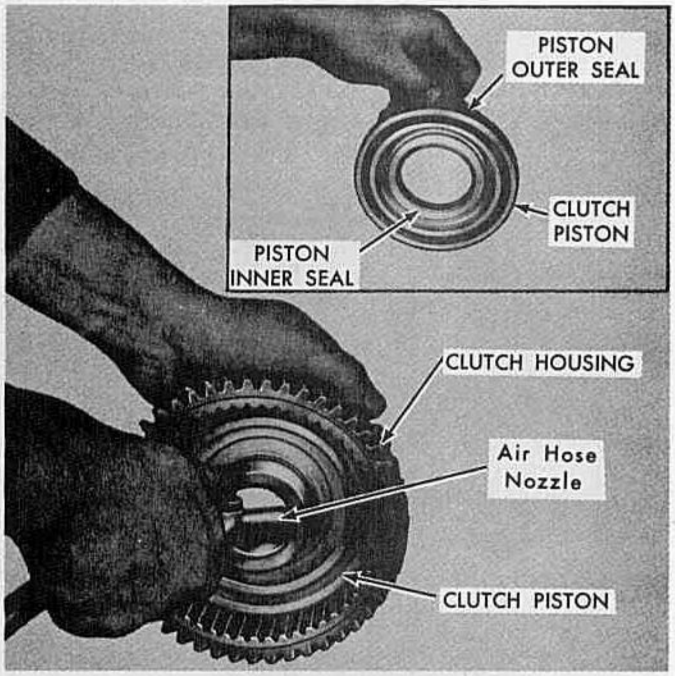


Figure 86
Clutch Piston Removal

3. Compress the piston return spring in a press with the Compressor, N-775, shown in Figure 85, then remove the snap ring. Guide the spring retainer while releasing the press to prevent the retainer from entering the snap ring groove.

4. Place an air hose nozzle in the hole in the hub, as shown in Figure 86, and force the piston out of the clutch housing with air pressure.

5. Remove the piston inner and outer seals, shown in the Insert, Figure 86.

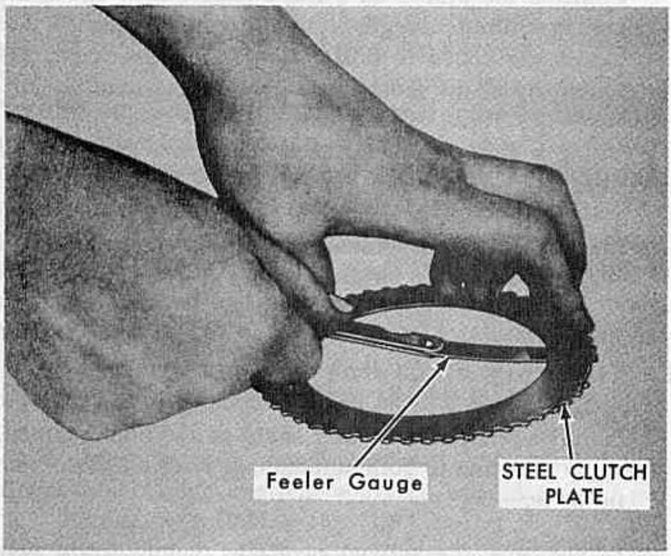


Figure 87
Checking Steel Clutch Plate Coning

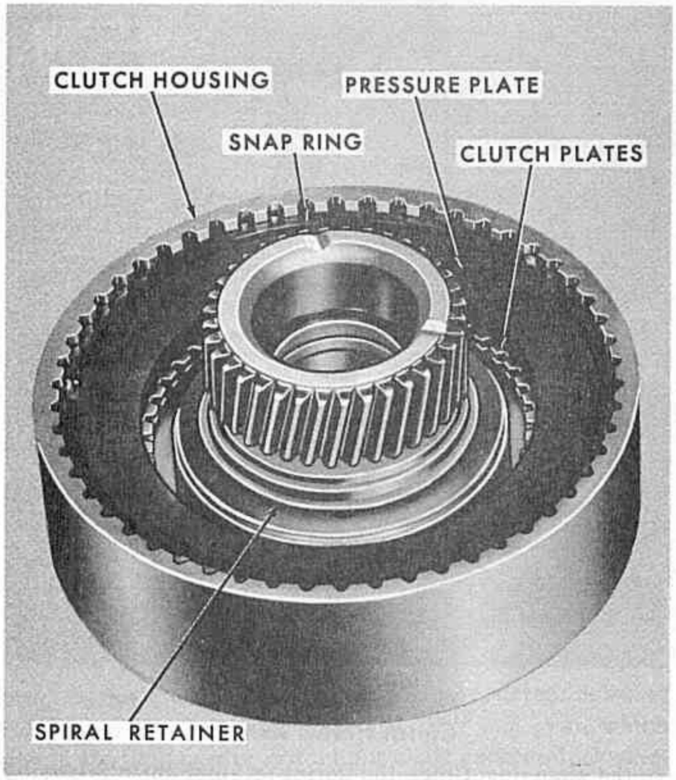


Figure 88
Direct Drive Clutch

6. Inspect the clutch piston and cylinder walls for scoring. Fine emery cloth may be used to smooth the surfaces. Check the fluid passages for obstructions.

7. Inspect the clutch plates for heat, distortion, wear, and scoring. Check the coning of the steel plates. Position the plates on a flat surface, then check the coning with a feeler gauge, as shown in Figure 87. The plates are coned to 0.015" – 0.020" clearance. Replace any of the plates with coning less than 0.015".

8. Using a straight edge, check the bronze plates to be sure that they are flat.

9. Inspect the clutch pressure plate for scoring and check the release spring for distortion.

I. Assembly of Clutch Packs

1. Install new inner and outer seals on the clutch piston, apply Vaseline to both surfaces, and install the piston in the housing.

2. Install the clutch release spring and retainer with Compressor, N-775, as shown in Figure 85. Compress the spring in a press and install the snap ring.

CAUTION: *Make sure the snap ring is fully seated in the groove.*

3. Install the steel and bronze clutch plates alternately, starting with a steel plate next to the piston. Because of coning, all steel plates must face the same direction; all concave (hollow) sides up when the clutch is being assembled.

NOTE: *In the two-speed P.T.O. transmission, the P.T.O. clutch pack contains six steel and six bronze plates. All other clutch packs, except the direct drive clutch, contain five steel and five bronze plates.*

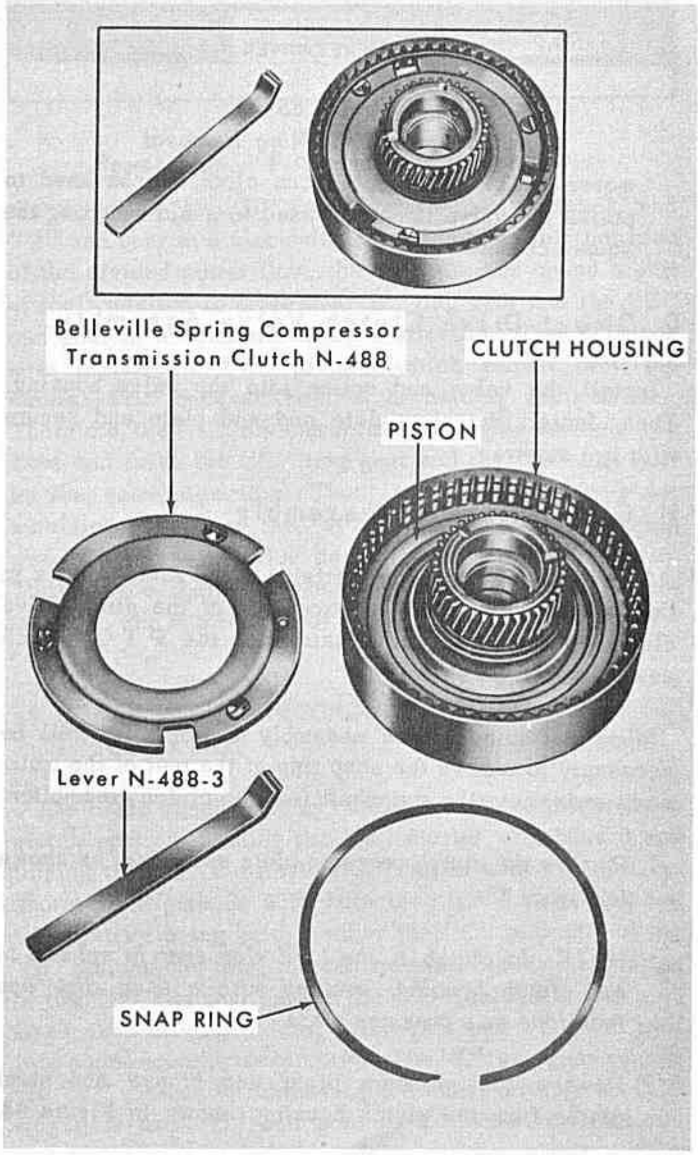


Figure 89
Special Tools for Disassembling Direct Drive Clutch

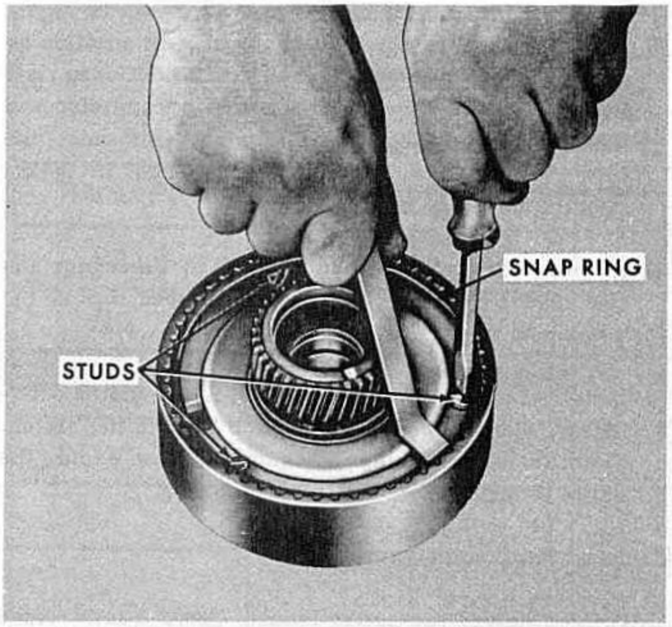


Figure 90
Compressing Belleville Spring in Direct Drive Clutch

J. Direct Drive Clutch Disassembly

1. Remove the large snap ring from the inside of the clutch housing, Figure 88, and lift out the pressure plate and the four clutch plates.
2. Position the Spring Compressor, N-488, in the clutch housing, as shown in the Insert, Figure 89, and install the snap ring. Make sure the snap ring ends are positioned away from the slots in the compressor.
3. Using the N-488-3 Lever and a screwdriver, as shown in Figure 90, engage the lowest step of each stud to the snap ring. Repeat this operation for engaging the second step and then the third step of each stud. At this point, the pressure of the spring washer against the snap ring will have been eliminated and the spiral retainer can be removed.
4. Reverse the procedure used in step 3 to disengage the compressor studs from the snap ring, then pry off the snap ring and remove the compressor.
5. Remove the small wire pivot ring, the spring washer, and the large wire pivot ring, Figure 91.

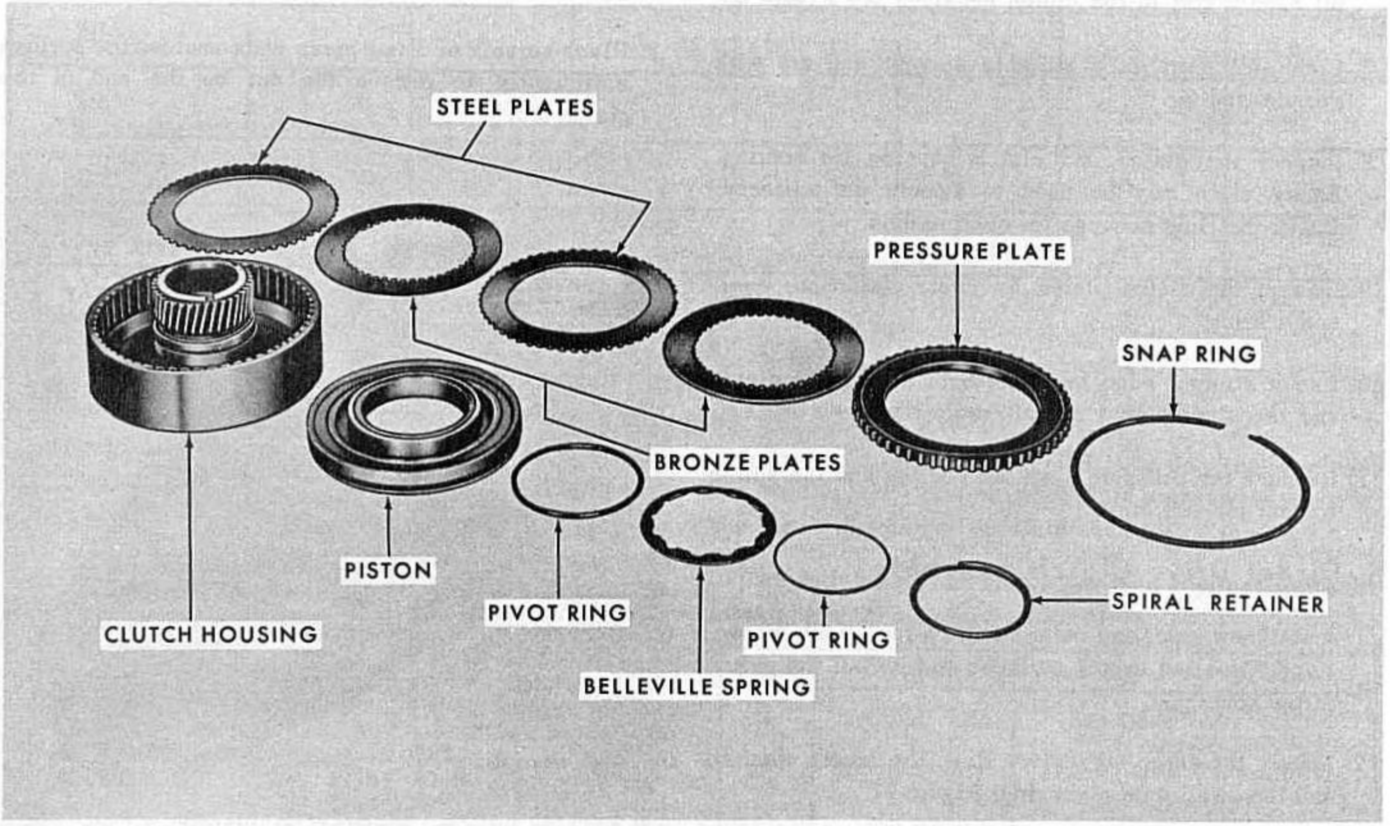


Figure 91
Direct Drive Clutch – Disassembled

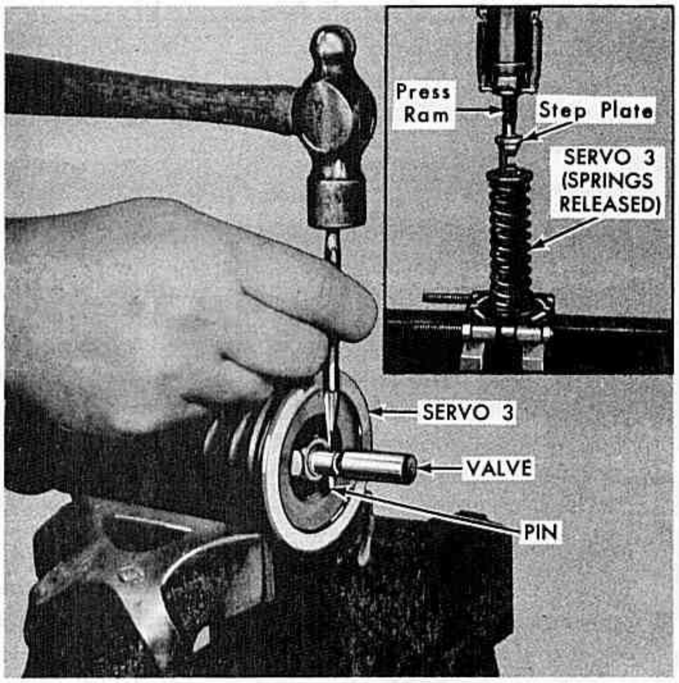


Figure 92
Servicing the Servos

6. Remove the piston by applying compressed air to the oil supply port in the clutch housing. See Figure 86.

7. Clean all parts in a suitable solvent and dry with compressed air.

8. Inspect the piston and clutch housing for scoring. Emery cloth may be used to smooth the surfaces. Check the fluid passage for obstructions.

9. Inspect the clutch plates for heat, distortion, wear, and scoring.

10. Use a straight edge to check both the bronze plates and the steel plates to make sure that they are flat.

11. Examine the pressure plate for scoring and the spring washer for distortion.

K. Direct Drive Clutch Assembly

1. Install new inner and outer seals on the clutch piston. Apply Vaseline to both surfaces and install the piston in the housing.

2. Install the large wire pivot ring, the spring washer, and the small wire pivot ring, Figure 91.

3. Position the Spring Compressor, N-488, on the piston, then install the large snap ring.

4. Using the lever and a screwdriver, as shown in Figure 90, depress the compressor and hold it in position by engaging the lowest step in each stud to the snap ring. Repeat this procedure to engage the second step and finally the third step of each stud. At this point, the spring will be sufficiently compressed to permit installation of the spiral retainer.

5. Reverse the procedure in step 4 to disengage the compressor from the large snap ring, then remove the large snap ring and the compressor.

6. Install the steel and the bronze clutch plates alternately, starting with a steel plate next to the piston. Then, install the clutch pressure plate and secure the entire assembly with the large snap ring.

L. Servos Disassembly

All three servos are spring loaded. Servo 1 is serviced as an assembly. All of the components of servos 2 and 3 are serviced.

1. Remove the valve from the end of servo 3 by driving out the pin with a suitable punch, as shown in Figure 92.

2. Place servo 2 or 3 in a press and compress the springs sufficiently to remove the nut on the end of the piston rod.

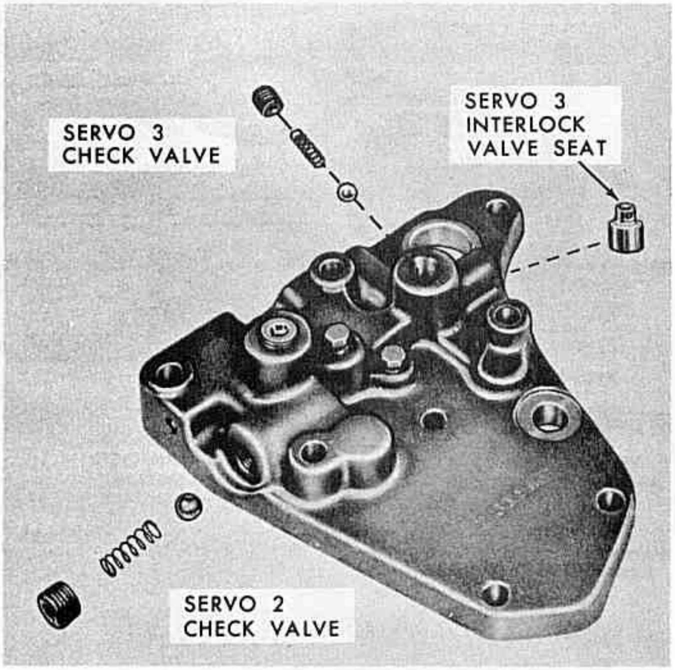


Figure 93
Servo 2 and 3 Cover Assembly

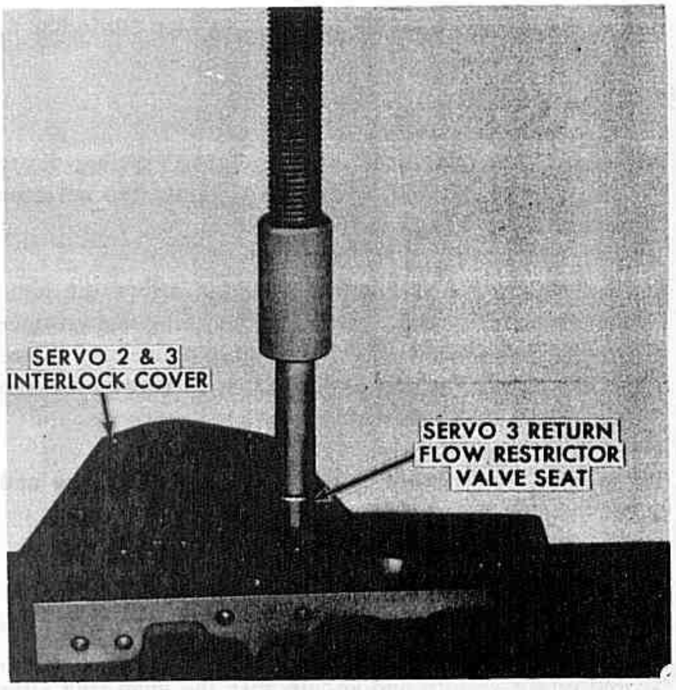


Figure 94
Servicing Flow Restrictor Valve

NOTE: *It is essential that the servo springs are evenly compressed to prevent damage to the parts.*

3. Slowly release the spring pressure until the springs attain their normal free length.

CAUTION: *If the servo piston hangs up on the rod, the servo springs should be again compressed and the burr removed. It should be noted that the springs in a compressed state possess considerable force and for this reason, the spring pressure should always be released gradually.*

M. Assembly of Servos

1. Compress the servo springs and install the nut on the piston rod.
2. When assembling servo 3, insert the sleeve over the piston rod and stake the valve pin after it is installed.

N. Servo 2 and 3 Cover Disassembly

1. Remove the valve pin from the inside of the servo cover.
2. Remove the hex socket plug, spring, and check valve from the opposite side of the servo 3 interlock valve seat. See Figure 93.
3. Press the valve seat from the cover using a suitable press.
4. Remove the hex socket plug from the servo 2 check valve and remove the spring and ball.
5. Inspect the balls, springs, and valve seats for damage. Replace defective parts as required.

O. Servo 2 and 3 Cover Assembly

1. Press the servo 3 interlock valve seat into the cover, as shown in Figure 94.

   NOTE: *The seat must be installed with the 5/16" diameter "thru" hole in a vertical position, i.e. when the cover is installed, as shown.*

2. Install the check balls, springs, and hex socket plugs. Insert the valve pin in the interlock valve seat.

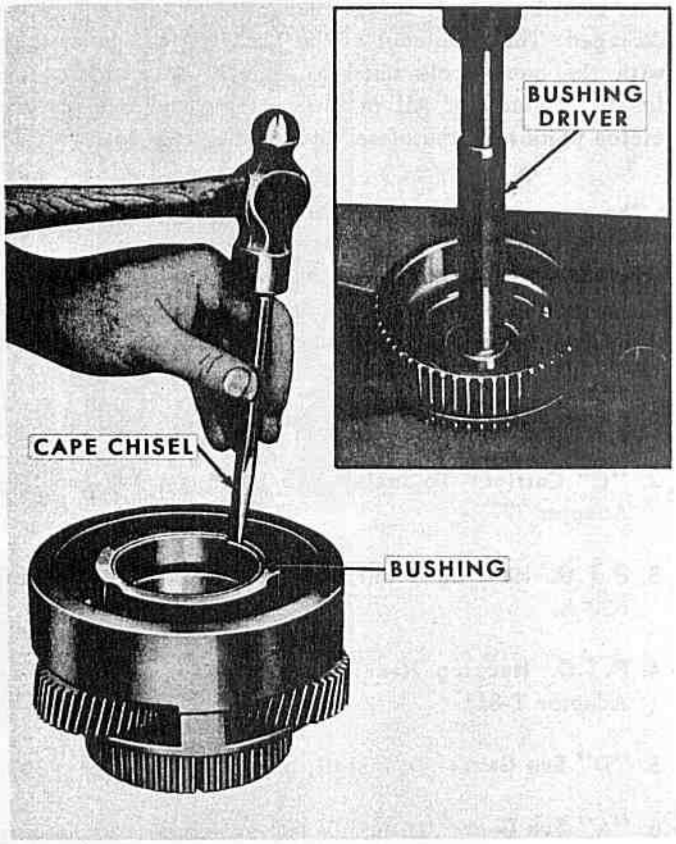


Figure 95
Bushing Removal

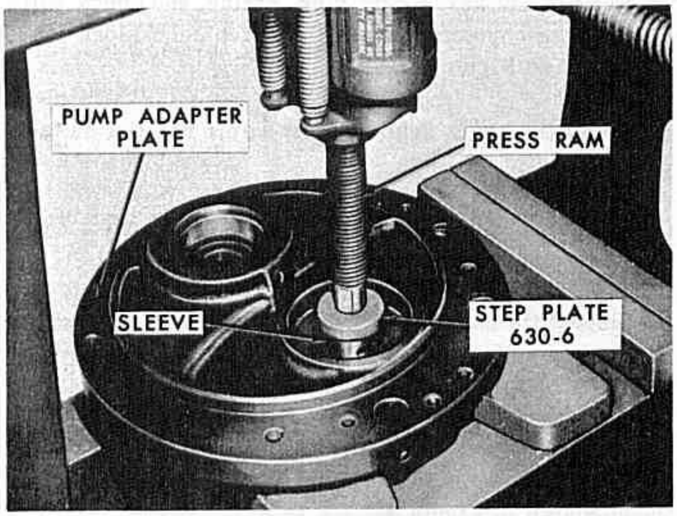


Figure 96
Servicing Pump Adapter Plate Sleeve

P. Bushings and Sleeve

The bushings which are serviced are listed below and shown in Figure 38. The first four bushings are to be removed with a cape chisel as shown in Figure 95. Extreme care must be used to insure that the bushing bores are not damaged. The remainder of the bushings can be removed with the same tools used to install the bushings. See Insert, Figure 95. All of the service bushings are precision parts and, therefore, need not be reamed.

The pump adapter plate sleeve is to be installed with the chamfered edge toward the rear (bearing side) of the plate. See Figure 96. Align the holes in the sleeve with the adapter plate holes and press the sleeve so that the chamfered end is flush with the recessed machined surface.

1. **Clutch 1:** To install, use Bushing Adapter 776.
2. **"C" Carrier:** To install two bushings, use Bushing Adapter 777.
3. **P.T.O. Housing Front:** To install, use Step Plate 630-A.
4. **P.T.O. Housing Rear:** To install, use Bushing Adapter T-811.
5. **"D" Sun Gear:** To install, use Bushing Adapter 809.
6. **"A" Sun Gear:** To install two bushings, use Bushing Adapter T-807.
7. **Rear Support:** To install, use Step Plate 630-9.
8. **Pump Adapter Plate:** To install, use Step Plate 630-6.

Q. Speed Selector Disassembly

1. Remove the two side covers, lever, spring, lever assembly, and three screws to separate the selector assembly, as shown in Figure 97.
2. Remove the hex nut from the shaft, remove the indicator assembly, and remove the snap ring and retainer plate to expose the wheel and cable assembly, shown in Figure 98. The shaft can now be withdrawn and the wheel and cable can be removed.
3. Inspect all parts of this assembly for damage and excessive wear.

R. Assembly of Speed Selector

1. Install the shaft, cable and wheel assembly, bushing, and retainer plate and secure with the snap ring after being certain that the cable is engaged in the wheel.
2. Secure the conduit to the fitting and push or pull the cable until 1/4" of the cable connector is protruding from the conduit.

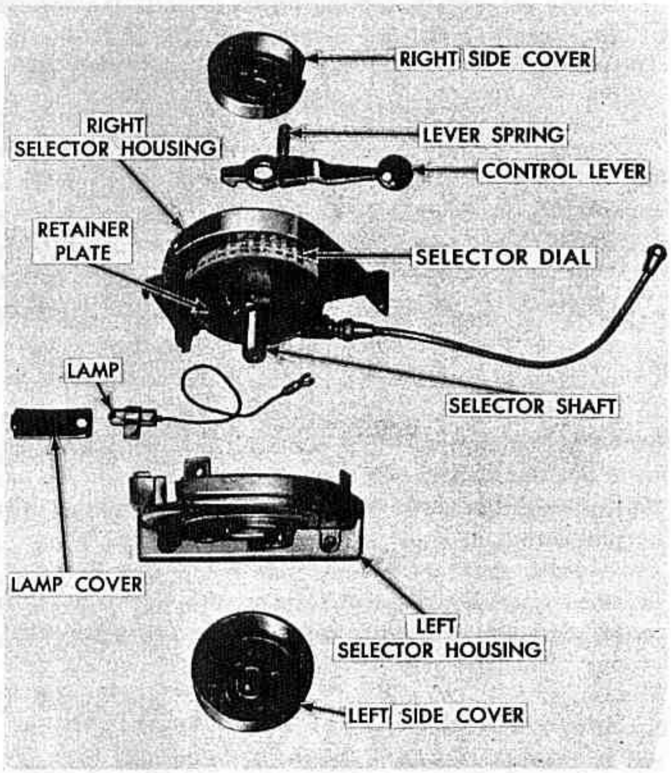


Figure 97
Selector Assembly Components

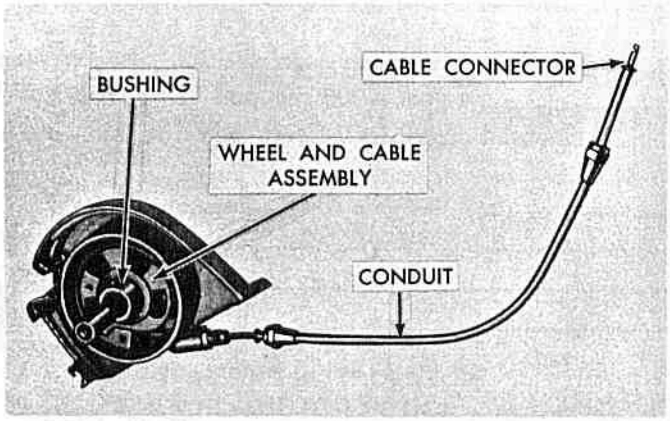


Figure 98

Servicing the Cable and Wheel Assembly

3. Install the indicator assembly and loosely thread the hex nut on the shaft. Align the selector dial to the housing by placing the indicator in the tenth speed position. Tighten the nut.
4. Install the lamp cover and secure the housing halves with three screws.
5. Install the control lever, spring, and notched side cover on the right end of the shaft. Install the remaining cover on the left side of the shaft.
6. Assemble the speed selector assembly on the tractor as covered on page 37. Final alignment of the dial to the housing is accomplished at that time.

11. SPECIFICATIONS – SELECT-O-SPEED TRANSMISSION

NOTE: *All specifications are given in inches unless otherwise specified.*

End Play

Front Transmission Compartment	0.005–0.015
Rear Transmission Compartment	0.005–0.015
Planet Pinion Gears	0.010–0.028

Preload

P.T.O. Shaft Bearing	18–25 lbs. pull

Servo Bore Diameter

Servo # 1	1.999–2.001
Servo # 2	2.125–2.127
Servo # 3	3.000–3.002

Band Adjustments

Band # 1 (released)	Back off one turn
Band # 2 (released)	Back off 3/4 turn
Band # 3 (released)	Back off 3/4 turn

Thrust Washers

Selective Front	0.062–0.122
Selective Rear	0.092–0.152

(Selective washers are available in increments of 0.010)

Reservoir

Fluid Specifications	M-2C-41 Hydraulic Fluid
Location	Transmission case
Capacity	12 quarts

Pump

Type	Roller vane
Capacity	4 gpm @ 900 rpm and 175 psi (120°F.)
Location	Mounted coaxially on transmission input shaft

Control and Direct Drive Clutch Valves

Valve Spool Diameters (Clutch Pack and Band Servo)	0.3738–0.3742
Valve Spool Diameters (Feathering)	0.3743–0.3747
Bore Diameters	0.3751–0.3758

Valve Spring Lengths

	Free	*Under Load*
Feathering Valves		
Plunger Springs (2)	1.22	0.78 @ 1.9–2.0 lbs.
Return Springs (2)	1.110–1.130	0.86 @ 7.85–8.85 lbs.
Detent (1)	0.70	0.58 @ 17–20 lbs.
Valve Spools (6)	1.24	0.45 @ 3.10–3.50 lbs.
System Relief and Regulating Valves (3)	2.06	1.665 @ 15.5–17.5 lbs.
Lubrication (1)	1.47	1.03 @ 3.76–4.24 lbs.
Direct Drive Clutch Control Valve Spring	1.90	1.44 @ 5.7–6.3 lbs.

Clutch Piston Return Springs

	Free	*Under Load*
Direct Drive Clutch Spring		
Height		0.115–0.125
Thickness		0.035–0.037
Clutch 1, 2, and 3 Springs	2.06	1.33 @ 200–225 lbs. 1.230 @ 255 lbs.
P.T.O. Clutch Spring	2.34	1.188 @ 200–225 lbs.

Servo Springs

	Free	*Under Load*
Servo #1	Assembly Not Serviced	1.44 @ 75 lbs.
Servo #2	6.54	4.92 @ 225–275 lbs.
Servo #3 inner	6.54	4.92 @ 225–275 lbs.
Servo #3 outer	7.86	5.44 @ 314–382 lbs.

Hydraulic Pressures at 800 Engine rpm and 120° F. Fluid Temperature

System Relief	180 psi ± 10 psi
Regulating (Partial Feather)	150 psi ± 5 psi
Lubrication (at Rear Support)	2 psi minimum

Torque Limiting Clutch

Belleville Spring thickness	0.091–0.094
Belleville Spring dish (free)	0.205–0.215

Disc with Lining thickness	0.333–0.347
Flywheel Clutch recess	2.026–2.032
Drive Plate thickness	0.278–0.282

Bushing Diameter

Clutch # 1 Housing	2.2178–2.2188
"C" Carrier (two)	3.0615–3.0625
"D" Sun Gear	0.999–1.000
Rear Support	1.749–1.750
P.T.O. Clutch – Front	1.874–1.875
P.T.O. Clutch – Rear	1.624–1.625
Direct Drive Clutch – Front	1.374–1.375
Direct Drive Clutch – Rear	1.249–1.250

Output Shaft Speed at 1750 Engine rpm

Speed	*Output Shaft rpm*
R_2	–202
R_1	–137
N	(Slight creep possible)
1	46
2	65
3	68
4	97
5	155
6	200
7	230
8	295
9	478
10	709

Torque Specifications

	Torque in Ft. Lbs.
Valve Body Mounting Bolts	5–8
P.T.O. Bearing Retainer Bolts	12–15
Pump Mounting Bolts	15–18
Adapter Plate Bolts	25–30
Distributor Mounting Bolts	20–25
Rear Support Mounting Bolts	35–40
Servo # 1 Cover Attaching Bolts	20–25
Servo Actuating Lever Pin Nuts	100–120
Lever Pin Retainer Bolts	90–110
Torque Limiting *Clutch Mounting Bolts*	25–30
Transmission Cover Attaching Bolts	18–23

CLUTCH PACKS COMPONENTS INTERCHANGEABILITY

Components	Direct Drive Clutch	Clutch 1	Clutch 2	Clutch 3	P.T.O. Clutch
Pressure Plate	D.D.	C 1	*	*	P.T.O.
Steel Plate	D.D.	*	*	*	P.T.O.
Bronze Plate	D.D.	*	*	*	P.T.O.
Piston	D.D.	C 1	*	*	P.T.O.
Outer Snap Ring	X	*	*	*	X
Inner Seal	D.D.	C 1	*	*	P.T.O.
Outer Seal	D.D.	*	*	*	P.T.O.
Spring	D.D.	*	*	*	P.T.O.
Seat	D.D.	C 1	*	*	P.T.O.
Inner Snap Ring	D.D.	C 1	*	*	P.T.O.

* Interchangeable parts.

X Interchangeable between D.D. and P.T.O. clutch only.

NOTE: *In 2-speed P.T.O. clutch there are 6 steel and 6 bronze plates, but single speed P.T.O. clutch has only 5 steel and 5 bronze plates.*

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